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COLLEGE NOTES

University of Arizona.—The only faculty change for the current year resulted from the retirement of Dr. F. N. Guild, Professor of Optical Mineralogy, who has taught in the University of Arizona for thirty-four years. He assumes an Emeritus Professorship. His place was filled by the appointment of Dr. M. N. Short, formerly with the U. S. Geological Survey, whose recent bulletin, No. 825, on the "Microscopic Determination of Opaque Minerals" is generally regarded as the last word on that subject.

The most significant feature about the enrollment in the college this year is the great increase in the number of graduate students. Twenty-five such students are registered, and three of them are candidates for doctorates. They come from institutions all over the country. Two of the students enrolled in the graduate course in the Administration of Mineral Industries have just spent respectively, two years and nine months in Russia as consulting engineers for the Soviet Government.

University of Arkansas.—Professor R. G. Paddock has been appointed head of the Mechanical Engineering department, College of Engineering, at the University of Arkansas, to succeed Professor C. H. Kent, who resigned to accept a position at Pennsylvania State College. Professor Paddock holds the bachelor and the master degree from Purdue, has had five or six years of teaching experience, as well as a like number of years of excellent practical experience.

Armour Institute of Technology.—Changes in Faculty, 1931–32:

Promotions: Melville B. Wells, from Professor of Civil Engineering, and in charge of Aeronautical Engineering, to Professor of Civil Engineering and Head of Department. Wm. C. Krathwohl, from Associate Professor to Professor of Mathematics and Head of Department. Henry T. Heald, from Assistant Professor to Associate Professor of Civil Engineering and Assistant to the Dean. Robert V. Perry, from Professor of Machine Design and Director of Evening Classes, to Dean of Evening Classes and Professor of Machine Design. Albert H. Krehbiel, from Associate Professor to Professor of Freehand Drawing and Water Color. Wm. F. McCaughey, from Assistant Professor to Associate Professor of Architectural Design. Richard J. Foster, from Assistant Professor to Associate Professor of Descriptive Geometry. Van Bau-

man Teach, from Assistant Professor to Associate Professor of Mathematics. James S. Thompson, from Assistant Professor to Associate Professor of Physics. Harold W. Haggard, Instructor, to Assistant Professor of Mathematics. Walter L. Suter, from Instructor to Assistant Professor of Architectural Design. Carl H. Johnson, from Instructor to Assistant Professor of Fire Protection Engineering. Emil R. Zettler, from Assistant Professor to Consulting Professor of Architectural Sculpture. Edward R. Gatley, from Assistant to Instructor in Machine Tool Work.

New Appointments: Sholto M. Spears, Assistant Professor of Civil Engineering; Harold A. Vagtborg, Assistant Professor of Municipal and Sanitary Engineering; Ross A. McReynolds, Assistant Professor of Economics; Watson M. Davis, Instructor in Mathematics; Carlyle Peek, Instructor in Elementary Machine Drawing; Homer Z. Martin, Instructor in Chemical Engineering; Hans Tropsch, Lecturer in Physical Chemistry.

Resignations: Ralph W. Hammett, Associate Professor of Architectural History; Donald S. Ullock, Instructor in Chemical Engineering and Curator of Chemical Laboratories; Russell H. Ewing, Assistant Professor of Economics.

Leave of Absence: Donald E. Richardson, Assistant Professor of Electrical Measurements.

Deaths: Claude I. Palmer, Dean of Students, Professor of Mathematics and Head of Department, died suddenly on April 8, 1931. Alfred E. Phillips, Professor of Civil Engineering and Head of Department, died on April 19, 1931.

Polytechnic Institute of Brooklyn started its 77th year, September 22, with a total registration of the day session of 527 students in the departments of mechanical, electrical, chemical and civil engineering. In the evening session 1,400 students were enrolled for undergraduate work while 205 students entered the graduate department. Registration of the new year shows a decided increase in the day session, the total of last year being less than 500, while in the evening session there is a slight decrease from last year's total.

Faculty appointments include: Dr. Raymond E. Kirk, former State Chemist and professor of chemistry, State College of Montana, to the newly created department of Pure Chemistry; Dr. Edward J. Thorndike, former instructor in physics, California Institute of Technology, to the Graduate department of Physics; Mr. James A. Parker, M.A., Columbia, to instructorship in department of English. Professor Vladimir Karapetoff of Cornell University will continue as visiting professor of Electrical Engineering in the Graduate departments. Dr. Ernst Weber, former visiting professor

to the Polytechnic from the Hochschule Technische, Charlottenberg, Germany, has accepted permanent appointment as professor of electrical engineering. Professor Clyde C. Whipple returns to Polytechnic after a year's leave of absence to teach in the department of electrical engineering at Princeton. Mr. Gerard E. Claussen, former Polytechnic honor student, returns this year after graduate study at the Massachusetts Institute of Technology as instructor in Mechanical Engineering.

The largest student body in the history of the **Carnegie Institute of Technology** began classes on September 30. Total enrollment was 2,521 students as compared with 2,434 at a corresponding time last year. In the upper classes of the College of Engineering, 742 students were enrolled. The combined freshman classes of the Colleges of Engineering and Industries numbered 396.

The graduate departments of the College of Engineering are gradually being enlarged. This semester 40 students are enrolled, the majority taking work in the Department of Metallurgy.

The U. S. Government has again assigned officers of the service for advanced study in the College of Engineering. Four officers of the U. S. Navy, all graduates of the Naval Academy at Annapolis, have been assigned for graduate study in metallurgy. They are Lieutenants, H. O. Dahlke, W. S. Newton, G. A. Holderness, and William C. France. Two graduates of West Point, Lieutenants Robert E Cron and E. E. Kirkpatrick, are studying civil engineering.

One of a group of 52 Russian students who were sent to this country for graduate work was accepted by the Department of Metallurgy. He is Mr. I. G. Liferenko.

Few faculty changes have been made for the year. Prof. Max M. Frocht, of the department of Mechanics, has returned after a leave of absence, during which he lectured and did research work at the University of Michigan. He received the Ph.D. degree. Charles E. Leberknight, former student, and instructor in physics, has rejoined that department after receiving the Ph.D. degree at Johns Hopkins University.

During the summer an additional chemistry laboratory was constructed in the College of Engineering. The new wing recently added to the building of the College of Industries will furnish a spacious drawing room for students in the Department of Drawing and Descriptive Geometry, as well as classrooms and office space. A floor was added in the gymnasium during the summer to be used by the students for social functions.

On the week of November 16 to 21, Carnegie Institute of Technology will hold the Third International Conference on Bituminous

Coal. Representatives of fifteen countries have accepted invitation of President Thomas S. Baker to participate in the meeting. Some 100 papers have been accepted by the committee in charge. Among the subjects to be treated by outstanding scientists are hydrogenation and liquefaction of coal, gasification, low and high temperature distillation, cleaning and preparation of coal, origin and classification of coals, smoke elimination, dust removal, pulverized fuels, railway and steamship fuels, by-products, etc. This year for the first time in these meetings a section on the economics of coal has been included in the program. Among the speakers in this group will be Mr. Myron C. Taylor, chairman of the Finance Committee of the U. S. Steel Corporation, and Dr. W. T. Thom, Jr., of Princeton University. The latter will deal with the interrelationships that exist between coal, petroleum and natural gas. Another section of the congress will be devoted to the competition between the major fuels. Dr. Thomas R. Alexander, of the Department of Chemistry, is secretary of the Conference, and Dr. Baker is the organizer. The proceedings of the congress will be published.

The first assembly of the students and faculty of **Case School of Applied Science,** held September 24, 1931, in the Case Club, marked the 50th anniversary of the first opening exercises of the college when a few students and five professors met in the old Case homestead on Rockwell Street in the fall of 1881.

This fall finds the Case enrollment approximately the same as that of last year. In addition to the undergraduate enrollment of 750 there are 25 graduate students who are completing the Master of Science degree.

New members of the faculty, introduced to the student body by the president, include Prof. E. W. McCullough, professor Mining Engineering; Dr. P. E. Hemke, Assoc. Prof. of Mechanics; Dr. Oldenburger, instructor in mathematics; Mr. R. V. Barrett, instructor in geology; Mr. Lee Strahl, instructor in English; and Mr. M. J. Crass, instructor in chemistry.

In an endeavor to bring together executives and engineers for the consideration of certain phases of engineering progress, Case School of Applied Science and The Cleveland Engineering Society last year started a series of Educational Industrial Conferences, held at Case, at which papers are presented by capable speakers followed by a general discussion of the subject by those interested. The intention is to acquaint those active in engineering and manufacturing development with the latest progress in some particular field in the hope that application of such knowledge will be stimulated. The conferences held last year met with such success

that the committee in charge, handled by Professor F. H. Vose, of Case, and Mr. George F. Burrows, of Cleveland Engineering Society, is planning for three such conferences to be held during the current school year.

The first of these, a conference on Metals and Alloys, scheduled for November 18, 19 and 20, has been planned to appeal to three groups:

1. Architects and structural engineers—treating the use of alloys in building and decoration.
2. Power and process engineers—treating the use of alloys requiring resistance to corrosion, high temperature, wear, fatigue.
3. Design and product engineers—treating the use of alloys in the manufacture of machine, aircraft and other products. This would include high strength—light weight alloys, bearing alloys, cutting alloys, hard alloys, etc.

With these three groups in mind, a comple and well-balanced program has been arranged, including an unusually brilliant list of speakers selected with no limitation upon affiliation or location. Dr. A. A. Bates, of Case School of Applied Science, just returned from a year's study in Europe, will speak on the general subject of "Metallurgy of Alloying." Dr. M. A. Grossman, Vice President and Director of Republic Research Corporation, will present the subject of "Stainless Steels." Mr. T. H. Wickenden, of the International Nickel Company, brother of President Wickenden of Case School, will tell of "Monel Metal and the Nickel Alloys." Mr. W. R. Hibbard, of American Brass Company, will represent the "Brass Bronze and Copper Alloys"; Mr. W. M. Pierce, of the New Jersey Zinc Company, "Zinc and Its Alloys"; Mr. L. W. Kempf, of the Aluminum Company of America, "Aluminum and Its Alloys." Other ferrous alloys and nitrided steels will also receive attention. Dr. John A. Gann, Chief Metallurgist of Dow Chemical Company, is arranging for presentation of the subject of "Magnesium Alloys."

At a session of special interest to those using alloys at high temperatures, Mr. H. J. French, Chairman of the Joint A. S. M. E.-A. S. T. M. Research Committee on Effect of Temperature on the Properties of Metals will present a discussion and review of the Symposium on this subject, held in Chicago this summer.

Mr. Magualo, of Cross and Cross, New York Architects, will describe the rapid development in the use of metals and alloys in the construction and decoration of recent New York buildings, in a special session for Architects and Structural Engineers. Mr. C. H. Bierbaum, Vice President of Lumen Bearing Company; Mr. Gurney, of Warner and Swasey Company; Mr. R. R. Moore, of Wright Aeronautical Corporation; and Dr. Karl Arnstein, of Good-

year Zeppelin Corporation; have been invited to present papers concerning the use of alloys in their respective fields. Several other able speakers will appear on the program.

In addition to the program of papers, a number of interesting demonstrations will be presented on each of the three days. These demonstrations will include among others a complete die casting process together with the special equipment and tests now being developed by Professor H. D. Churchill for research in this field; special X-ray equipment and demonstrations by Dr. Kent R. Van Horn, of the Aluminum Company of America, and by Dr. Christian Nusbaum, of Case School of Applied Science; electric and gas welding of various alloys; physical and metallurgical tests on alloys.

Exhibits of testing apparatus, light-weight alloys, corrosion resisting alloys, wear resisting alloys, hard alloys, alloys for architectural and structural use, should also be of considerable interest to those in attendance.

The second conference covering the general subject of "Air Conditioning" will be held in January and will be under the direct control of Professor F. H. Vose and Professor G. L. Tuve, of the Department of Mechanical Engineering. The third conference is scheduled for March and will cover the field of "Industrial Fuels." This conference will be planned by Dr. W. R. Veazey and Dr. C. F. Prutton, of the Department of Chemical Engineering."

The Colorado School of Mines opened its 58th year with the largest enrollment ever recorded by this second oldest mining school in the United States. Five hundred and sixty-seven embryo engineers have registered at the School of Mines this year.

In view of the fact that the Colorado School of Mines curriculum includes only subjects pertaining to the training of engineers for mineral industries, an enrollment of 567 may be considered quite large. Four degrees are offered by the Colorado School of Mines: engineer of mines, engineer of metallurgy, petroleum engineer, and geological engineer.

The School of Mines chapter of S. P. E. E., established a year ago, will continue its activities on the campus this fall under the leadership of Professor R. A. Baxter, president, Professor I. A. Palmer, vice-president, and Professor G. W. Salzer, secretary. Regular meetings are to be held, and speakers will be secured to talk on different subjects throughout the year.

One of the features of the curriculum of the Colorado School of Mines is the course in engineering English, the only laboratory course in English offered in this country. This course was introduced last year by Dean Jesse R. Morgan, and has proved a notable success.

University of Colorado.—Professor Herbert Gilkey has resigned from the Department of Civil Engineering in order to accept the headship of the Department of Applied Mechanics at Iowa State College, Ames, Iowa. Members of the faculty on leave for the coming year are Professor M. S. Coover, electrical engineering; associate Professor Glen Wakeham, chemistry; assistant Professor Frank C. Walz, physics, and assistant Professor Warren O. Thompson, geology. Those who have returned from leaves of absence are assistant Professor Harlan B. Palmer, electrical engineering and assistant Professor Julian M. Blair, physics.

New members of the faculty are Riley Cass, instructor in civil engineering, and L. B. Sutherland, instructor in civil and architectural engineering. Cass graduated from the University of Colorado and Sutherland from the University of Illinois. Mr. L. C. Weathers, who was a temporary instructor last year in electrical engineering, has been made a regular member of the department.

Dean H. S. Evans attended the meeting of the Kansas-Nebraska section of the S. P. E. E., held at Kansas State College, Manhattan, Kansas, on October 2 and 3.

All departments in the college report a large increase in the number of graduate students, though the exact number is not yet known.

Columbia University.—New appointments to the faculty staff: Bakhmeteff, Boris, A., Graduate, Institute of Engineers of Ways and Communications, St. Petersburg, 1903, Adjunct Applied Mechanics (Doctor of Engineering), Royal Polytechnical Institute, St. Petersburg, 1911, Professor of Civil Engineering; Baker, George W., B.S., 1930, E.E., 1931, Columbia, Assistant in Electrical Engineering; Brown, Harold J., B.S., M.I.T., 1930, Assistant in Electrical Engineering; Hicks, James R., B.S, Georgia School of Technology, 1930, Instructor in Mechanical Engineering; McNeil, Clayton T., Engineer of Mines, Michigan College of Mines, 1928, Instructor in Assaying, Mason, Henry Lea, B.Sc., Rutgers, 1921, M.E., 1926, Assistant Professor of Mechanical Engineering; Russell, John B., B.S., M.I.T., 1929, Candidate for the Doctor's degree at M. I. T., 1932, Instructor in Electrical Engineering.

Necrology: Everett Joel Hall, Assistant Professor of Assaying, was born in New York City, on October 3, 1877, and died there September 2, 1931. He studied both at Stevens Institute of Technology and at Columbia University and after some experience as a chemist in industry and as an assayer in India became assistant to Henry Howe at Columbia and later tutor in assaying there. He retained this connection through the rest of his life, eventually

becoming professor and executive officer of the School of Mines. He did much consulting work especially in the development of processes for obtaining potash and for making powdered metal, his process having been commercially exploited by the Metals Disintegrating Company.

At the April, 1931, meeting of the Faculty of Engineering, it was decided to award the degree of Master of Science under the Engineering Faculty for individual curricula of not less than 30 points, majoring in general, in the field in which the candidate holds the B.S. or equivalent degree, subject to the approval of the head of the department of major interest, the Dean and Committee on Instruction. The plan is now in operation and 25 men are working for this new degree.

For many years past, **The Cooper Union** has begun its year's work with all classes filled to capacity and the present year, the seventy-third of its existence, is no exception to this statement. Due, however, to the present business depression, an increased application list has caused the entering classes to be chosen from much larger groups than in past years. For example, the Institute of Technology, in its Day Engineering courses, admitted 103 students to the Freshman year from some 530 taking the entrance examinations. This, of course, means that the median intelligence rating in the Freshman group is appreciably higher than that in any previous years.

Two distinct changes have been made to the Engineering courses of the Institute of Technology: (*a*) German has been introduced as a prescribed subject for Chemical, Electrical, and Mechanical Engineering students, with the object of training the student to a point where he can read a technical article from the German without too great difficulty; for Civil engineers, Spanish has been added as a prescribed subject with the definite purpose of making it useful to such students as may engage in work in the Latin American countries. (*b*) The Courses given by the Chemical Engineering Department to non-Chemical Engineering students have been completely reorganized and coördinated. A new laboratory devoted to Metallography has been added, in order to supplement the new courses in Metallurgy. In it are contained two large size photo-micrographic apparatus, a furnace for studying the behavior of metals at high temperature in an atmosphere of various gases, together with the usual equipment of polishing and grinding machines, microscopes, automatic temperature recording potentiometer, etc. A course on the Physical Chemistry of Molecules, Atoms, and Electrons has also been added, together with a new laboratory devoted to Electron Physics. This permits student

experiments to be made on the charge of the electron, with the degree of precision which in the past has been attained only by research workers. The laboratory contains Millikan's apparatus for the measurement of the charge of the electron, apparatus for spectroscopic measurements of high precision, apparatus for the measurement of ionization currents, for the study of the photo-electric cell, and of vacuum tube characteristics.

The Department of Chemical Engineering is continuing its work with the graduate chemical engineers in New York City by offering two courses of free evening lectures, one on the Unit Operations of Chemical Engineering by Dr. Albert B. Newman, head of the Department, and the other on Chemical Thermodynamics by Mr. James Coull. These classes are extremely well attended and it is felt that a distinct service is rendered to the profession by them.

Dr. Newman is at work on two papers for the coming meeting of the American Institute of Chemical Engineers on the Drying of Porous Solids. In the paper pertaining to the Diffusion and Surface Emission Equations, the Chemical Foundation has given him a liberal grant for the necessary computations which will make the equations of the paper available graphically for use by engineers in the industry.

In the Electrical Engineering Department, the Electrical Machine Laboratories have been completely rearranged and seven new DC–AC generators added. The Electrical Measurements Laboratory is now in the course of rearrangement, and during the summer a Wolff Kompensations-Apparat was added to its Potentiometer equipment.

In the Department of Mathematics, Dr. H. W. Reddick, the Professor-in-Charge, has just completed the first quarter of his treatise on Differential Equations and has made it available to mimeographed form for his classes.

In keeping with the custom of the Cooper Union to send representatives to various centers of activity, Mr. James Coull, instructor in Physical Chemistry, and Mr. Charles H. Lehmann, instructor in Mathematics, attended the S. P. E. E. summer schools at the Universities of Minchigan and Minnesota, respectively, and at the annual convention of the Oil and Gas Power Division of the American Society of Mechanical Engineers, Mr. Herbert F. Roemmele, of the Department of Mechanical Engineering, was the official delegate from The Cooper Union.

For a number of years past, it has been the practice of The Cooper Union to give a liberal scholarship to any exceptional student upon graduation, in order to pursue further specialized study at another institution. This year, Mr. James J. Murphy,

'31, has received such a grant of $1,000 from the Emil Schweinburg Fund for a year's graduate work in Mathematical Physics at Cornell University, and Mr. David Rabinow, '31, a similar grant for a year's graduate work in Electrical Engineering at the same university. From the same fund, Mr. Charles J. Stolzenbach, '31, received a grant of $300, augmenting his Bloede scholarship of the Chemists' Club, in order to take a year's graduate work in Chemical Engineering at Columbuia University.

The following additional instructors to the regular staff have been appointed: Department of Electrical Engineering, for full time day and night duties—Mr. Ernest W. Starr, Cornell, '25, formerly of Engineering General Department, General Electric Company, Schenectady, New York. Department of Chemical Engineering for night instruction—Mr. Raymond J. Kunz, '31, who is connected with the Research Laboratories of the Electrolux Corporation, New York City.

Replacing resignations on the staff, there have been added the following instructors: Department of Machine Design, for full time day and night duties—Mr. Austin H. Church, Cornell, '28, formerly of the Steam Turbine Works of the Westinghouse Electric & Manufacturing Company at Philadelphia, Pa. Department of Physics, for night instruction—Mr. A. P. Craig, Cornell, '27, of the Industrial Sales Department, Westinghouse Electric & Manufacturing Company, New York City. Department of Mathematics, for night instruction—Mr. Lester A. Kenworthy, '31.

A notable addition has been made to the Board of Trustees, filling the vacancy rendered by the death of Mr. Thomas Snell, in the appointment of Mr. Walter S. Gifford, president of the American Telephone and Telegraph Company. The other members of the Board are Mr. R. Fulton Cutting, President; Mr. J. P. Morgan, Mr. Gano Dunn, and Mr. Elihu Root, Jr.

Ecole Polytechnique.—The School of Engineering opened this year on September 29th with an enrollment of 289 students. The course is of five years duration. There is only one curriculum, that of general engineering, and all the lectures are given in the French language. Before the year is completed a new hydraulic laboratory will be in operation; this laboratory designed especially for teaching and demonstration purposes will be quite complete, and one of the finest in Canada.

Georgia School of Technology.—The Coöperative Department has adopted the Quarter plan beginning July, 1931, the students alternating in school a quarter and then working a quarter.

Prof. Montgomery Knight, who is in charge of the Aeronautics at Georgia Tech, is a graduate of M. I. T. and from 1925 to 1930 was

a member of the National Advisory Committee for Aeronautics at Langley Memorial Laboratory.

In spite of so-called "depression" the enrollment at Georgia Tech is as large this year as formerly.

The **Harvard Engineering School** is offering this year a new course in the field of aerodynamics and the related subject of hydrodynamics. This course involves the study of the flow of fluids and of air with special reference to airplanes and airships. Other applications, however, will be included, such as certain features in the design of hydraulic turbines and propellers, and the vibration of electric transmission lines caused by wind. Due to its fundamental character this course is required as a part of the program of all mechanical engineers in the Engineering School, but it is being taken by students in other fields and by graduate engineers now engaged in industry. The lecturer is Dr. J. P. Den Hartog, who is head of the Dynamics Section of the Westinghouse Research Laboratories at East Pittsburgh.

This course is closely coördinated with a course given during the second half year on the subject of mechanical vibrations, having as lecturers Mr. J. Ormondroyd of the Westinghouse Company and Mr. A. L. Kimball, Jr., of the General Electric Research Laboratories. Both of these courses are part of the offering in the department of Applied Mechanics and are intended to emphasize the importance of mathematics and physics in the analysis of problems arising in mechanical engineering and aeronautics.

University of Illinois.—Professor C. W. Parmelee, Head of the Department of Ceramic Engineering, and Professor Hardy Cross, Professor of Structural Engineering, returned to the University September 1 after a year's absence on sabbatical leave.

Professor Parmelee spent most of his time in England, France, and Germany, and made short excursions into Italy, Holland, and Czechoslovakia. His purpose during his sabbatical leave was to acquaint himself with the ceramic industries of Europe and the status of their research work, to visit mines and other sources of ceramic materials, factories engaged in the production of clayware, glass and enameled metals, museums, schools, and laboratories. He reports a pleasant and valuable sojourn.

Professor Cross spent his sabbatical leave in Europe to get at first hand the point of view of European engineers on methods of design and construction, particularly of concrete and masonry structures. Professor Cross feels that his year abroad has enabled him to get a much broader viewpoint of his work in conducting his graduate courses, and this he finds especially valuable in view of the fact that many of his graduate students come from foreign countries.

Professor Herbert Fisher Moore, Research Professor of Engineering Materials, returned October 8 after visiting for two months in Europe. Professor Moore attended the Congress of the International Association for Testing Materials which was held at Zurich, Switzerland, September 6–12. He served as chairman of the American delegation, and presented a paper entitled "Calibration of Testing Machines." The next Congress will be held in London either in 1934 or 1935. Following the Congress Professor Moore attended a meeting of the British Institute of Metals which was also held in Zurich, September 13–15. On his way to Zurich Professor Moore visited for four days at the British National Physical Laboratory at Taddington, near London. In all, Professor Moore visited some twelve physical laboratories in England, Germany, and Switzerland.

Professor Ellery Burton Paine, Head of the Department of Electrical Engineering, returned late in September after spending the summer in Europe where he visited a number of electrical laboratories to acquaint himself with the work which is being done abroad in cable research work.

Dr. H. M. Westergaard, Professor of Theoretical and Applied Mechanics, and Mr. J. J. Doland, Associate Professor of Civil Engineering, have been rendering service as technical experts for the U. S. Government. Professor Westergaard spent all of 1929–30 and the summer periods since making a mathematical analysis of the Hoover Dam. Professor Doland has been spending his summer vacation periods in the U. S. Engineers Office of the War Department in Kansas City, Missouri, in connection with hydraulic investigations directed by the U. S. Flood Control Act of May 15, 1928. His work has involved hydraulic studies on all streams in the Missouri River Basin and a report of appraisals of its water resources.

Dean Milo S. Ketchum was engaged last spring as expert consultant by the Commissioners of Lincoln Park and the Chicago City Plan Commission to render a report on the type of material best suited for filling in Lake Michigan in connection with the Lincoln Park Extension Work.

Professor A. C. Willard, Head of the Department of Mechanical Engineering, has been named a member of President Hoover's Committee on Fundamental Equipment of the President's Conference on Home Building and Home Ownership. The Committee will make a study of existing conditions and practices relating to heating, lighting, ventilation, plumbing, refrigeration, humidification, and other types of equipment built into the house. The purpose is to draw up standards with reference to performance, economy of type, and serviceability.

Professor Willard and Professor F. R. Watson, Professor of Experimental Physics ,are both coöperating with the City of Chicago as consultants to the Advisory Subway Engineering Commission in the design of an extensive subway system for Chicago. Professor Willard is devoting his attention to problems of ventilation and Professor Watson, who is a specialist in acoustics, to the problem of minimizing the noise in the subway tubes.

In connection with these consulting features the Engineering Experiment Station is carrying out a test program on scaled sections of the tunnels in each of the fields mentioned.

Last June Dr. A. N. Talbot, Professor of Municipal and Sanitary Engineering, *Emeritus,* was awarded the George R. Henderson Medal by The Franklin Institute "in recognition of distinguished contributions in the field of railway engineering." This recognition of Dr. Talbot's railroad work came to him through his research on stresses in track which he has been carrying on for a number of years in coöperation with the American Railway Engineering Association and the American Society of Civil Engineers.

September 1, 1931, marked the separation of the curricula in architecture and architectural engineering from the College of Engineering. The Department of Architecture was transferred to a newly organized College of Fine and Applied Arts, where it is hoped that the students in architecture will reach their best development in the cultivation of aesthetic taste and artistic appreciation. The new College of Fine and Applied Arts for the time being consist of the School of Music, the Department of Architecture, the Department of Art and Design, and the Division of Landscape Architecture and City Planning.

A new assistant professorship in Physics was established effective September 1, 1931. The appointee is Dr. Peter Gerald Kruger, a graduate of Carleton College in 1925. He has taken several years of graduate work at Cornell University and the University of Berlin, and is the author of many important scientific articles which have appeared in the physical journals of America and Germany.

The Rails Investigation which is being carried on in the Engineering Experiment Station in coöperation with the Rail Manufacturers' Technical Committee and the American Railway Association is going forward at a very gratifying pace. Professor H. F. Moore is director of the investigation and is ably assisted by Professor H. R. Thomas. The purpose of the investigation is to determine the causes of failures in railroad rails.

Registration in the College of Engineering on October 1 was 1,352, which is practically the same as the registration of last year. The registration of graduate students in Engineering has increased

enormously. In one department alone there are 42 graduate students.

University of Iowa.—The only change in the faculty this year was the resignation of Dr. W. M. Young, associate professor of electrical engineering, and the appointment of George F. Corcoran in his place. Dr. Young has taken charge of research for the Taylor Instrument Company of Rochester. Professor Corcoran comes from a similar position at Kansas State College. One new position was created in the appointment of C. L. Lovell as instructor in chemical engineering.

The graduate enrollment has increased about 110 per cent over last year while the undergraduate enrollment is about four per cent less. A larger proportion of students who were eligible to return actually returned than did last year. Because of a change in scholarship standards, about twice as many students were dropped as in the preceding summer; the greater number dropped more than account for the decrease in enrollment.

The new mechanical engineering laboratories building will be completed about the first of December. It is a three story building faced with Bedford limestone. Slow shipments of the stone has delayed the work some two months behind schedule. The new building will embody several new policies in educational method.

All of engineering drawing has been moved to the third floor of the Electrical Engineering Building to make more room in Engineering Hall for the enlarged upper classes, and more particularly for graduate groups. The new quarters of the drawing department have been entirely remodeled, refinished and refurnished.

Johns Hopkins University.—Mr. E. H. Lange, of the Electrical Engineering faculty, resigned at the end of the academic year, 1930–31.

New appointments to the faculty have been: Dr. F. Hamburger, Jr., in the Electrical Engineering Dept., Mr. Leslie E. Herbert, formerly of Cornell, in the Mechanical Engineering Dept.

There has been a large increase in both the undergraduate and graduate departments of the day school.

Kansas State College.—On March 9, 1931, Governor Woodring approved an act of the Legislature by which the name of the Kansas State Agricultural College was changed to "The Kansas State College of Agriculture and Applied Science." Engineering students, faculty, and graduates of the institution need no longer feel that their activities are not reflected in the name of the institution.

Very few changes have taken place in the personnel of the faculty for the current school year. Associate Professor B. B.

Brainard, who was on a leave of absence last year to take graduate work at the Massachusetts Institute of Technology, is back on duty in the Mechanical Engineering Department. Assistant Professor George F. Corcoran of the Electrical Engineering Department has resigned to accept a position at the State University of Iowa. His place will be taken by LeRoy C. Paslay, a graduate of Kansas State, with experience in the research laboratories of the General Electric Company. Instructor A. F. Loomis of the Shop Practice Department has resigned to take up work in another vocational teaching field. Instructor P. M. Noble of the Applied Mechanics Department has resigned to acccept a position in the Reclamation Service at Denver. His place will be filled by Delos C. Taylor, formerly employed in the Road Materials Laboratory of this College.

Ten graduate teaching and research assistants have been added to the staff this year as follows: In the Agricultural Engineering Department, E. E. Karns; in the Architecture Department, R. I. Lockard; in the Civil Engineering Department, W. E. Steps; in the Electrical Engineering Department, K. D. Grimes, Eugene F. Peterson, H. H. Higginbottom, and A. S. Brown; in the Department of Applied Mechanics, F. M. Adair; in the Department of Machine Design, Mr. Clyde Newman; and in the Department of Mechanical Engineering, Mr. Leslie Aspelin.

Lafayette College.—Prof. William B. Plank, Head of the Department of Mining Engineering, has been granted Sabbatical leave and is abroad, visiting various Mining Engineering schools in Europe.

Prof. Paul B. Eaton has been made Head of the Department of Mechanical Engineering.

Edwin A. Goodrich, Instructor in Civil Engineering, has resigned.

Prof. Charles W. MacDougall has been forced to give up the Assistant Professorship in Mechanical Engineering because of ill health.

Paul P. Rice and Harry L. Anthony have been appointed instructors in Civil Engineering and Mining Engineering, respectively.

John R. Wilkins has been appointed Shop Assistant in Mechanical Engineering.

Prof. Harold J. Kennard has been advanced from Assistant to Associate Professor in Graphics.

Prof. E. M. Fernald has been advanced from Assistant to Associate Professor in Mechanical Engineering.

Charles M. Merrick has been advanced from Instructor to Assistant Professor in Mechanical Engineering.

Provision has been made for graduates of the Class of 1931 who have been unable to obtain positions, to continue their studies during the coming year under special financial arrangements.

McGill University.—Professor Ernest Brown, M.Sc., M.Eng., Professor of Applied Mechanics and Hydraulics has been appointed Dean of the Engineering Faculty at McGill University, taking the place of the late Dean Henry Martyn Mackay.

Dean Brown has been at the University for twenty-five years, coming to Canada in Sept., 1906, from the University of Liverpool, where his career as an undergaduate, graduate student and lecturer started with much promise.

This early promise of distinguished service has been amply fulfilled, his service at McGill being distinguished for scholarship loyalty and broad human interest and sympathy.

His appointment as Dean has met with the unqualified approval not only with the Alumni, his colleagues and the wide circle of his professional contacts but with the undergraduate body as well.

In view of Canada's peculiar position with regard to fuel for its industrial interests a Coal and Fuel Symposium will be held at the University during the last weeks of October and the first of November. A series of eight lectures will be given, each by a recognised authority on the subject presented. This is given under the aegis of the Department of Fuel Engineering in the Graduate School.

The Engineering Faculty is peculiarly fortunate in securing the services of Mr. Gordon Pall, Ph.D., for the Department of Mathematics. Graduating with honors from the University of Manitoba he went to the University of Chicago where he obtained his Ph.D. degree. Later he obtained a National Research Fellowship (U. S. A.) and with this spent two years at the California Institute of Technology.

We welcome this promising young Mathematician and trust he will find at McGill an atmosphere and interest which will be both helpful and stimulating.

Newark College of Engineering.—Scientific management is being given a prominent place in the curriculum of the Newark College of Engineering. In March, 1931, a room in the College was dedicated to the late Frank B. Gilbreth, famous for his founding of several movements in scientific management and motion study of human beings.

The aeronautical engineering course was inaugurated this year. The training will stress production, invention, and maintenance of power plants.

Six new instructors have been added to the staff of the Newark College of Engineering.

Clifford H. F. Cottee, a graduate of McGill University and Pennsylvania State College, will teach metallurgy.

David E. Davis, an instructor at Stevens Institute, and the University of Porto Rico, has joined the mechanical engineering department.

Frank J. Burns, a graduate of the Newark College of Engineering, is an instructor in engineering drawing.

In the electrical engineering department, a new arrival is Paul C. Shedd, a graduate of Worcester Polytechnic Institute and Massachusetts Institute of Technology. Formerly an instructor at Worcester Polytechnic and at Washington and Lee University, he was research engineer in magnetic testing for the American Steel and Wire Company until he came to the Newark College.

Arthur S. Kohler, a graduate of Brooklyn Polytechnic Institute, and a former instructor there, will teach in the chemistry department.

North Dakota Agricultural College.—The following instructors have been added to the engineering faculty of North Dakota Agricultural College:

Mr. Waldo E. Smith, Assistant Professor of Civil Engineering; Mr. Smith received both his B.S. and M.S. degrees in Civil Engineering from the University of Iowa. He taught one year at the University of Illinois as instructor in Theoretical and Applied Mechanics, from which position he resigned to accept a teaching position in Robert College of Engineering, Constantinople, Turkey, where he held the position of Associate Professor until last spring when he resigned to return to the States.

Mr. M. E. High, Instructor in Physics; Mr. High received his A.B. degree from McPherson College in Kansas, after which he spent two summers on physics and mathematics at Chicago University, and has been at Ohio State University for the past four years. During this time he has been teaching and doing graduate work. He received the A.M. degree in 1928 and his Ph.D. degree from the Ohio State University last spring.

Mr. Foster E. Buck, Instructor in Electrical Engineering; Mr. Buck holds a M.S. degree in Electrical Engineering from the University of Pittsburgh and has been for several years employed as Design Engineer by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. He resigned his position with that company to associate himself with the faculty here.

Northeastern University.—Dean Carl S. Ell has announced three new appointments to the Faculty of the Day Division of

Northeastern University for the school year 1931–1932: Roger Stanton Hamilton has been appointed Instructor in Economics; Asa S. Knowles, Instructor in Business Management; Donald Hershey MacKenzie, Instructor in Chemical Engineering.

The following promotions have also been announced: Eliot F. Tozer, from Associate Professor to Professor of Drawing; Edward S. Parsons, from Assistant Professor to Associate Professor of Physical Training; Winslow Porter, from Instructor to Assistant Professor of Banking and Finance; George H. Meserve, Jr., from Instructor to Assistant Professor of Drawing; William C. White, from Instructor to Assistant Professor of Education.

University of Pittsburgh.—Late registrations in the Schools of Engineering and Mines bring the total above last year's record year. The following new instructors have just been engaged for teaching positions on account of unexpectedly large registrations in the Schools of Engineering and Mines:

Linn Helander, B.S., Assistant Professor of Mechanical Engineering; graduate of the University of Illinois and has had twelve years experience in the design and erection of power plants and power plant machinery.

Andrew C. Havens, B.S., Instructor in Civil Engineering, graduate of the University of Pittsburgh. Mr. Havens has had several years experience in bridge design and construction.

Bert V. Hoard, M.S., Instructor in Electrical Engineering, graduate of the University of Washington, with five years' experience in Electrical Engineering with the Westinghouse Electric & Mfg. Co.

Milo J. Stutzman, Ph.D., Instructor in Metallurgy, graduate of the University of Iowa with eight years' research experience in general Metallurgy and heat treatment of metals.

G. R. Fitterer, M.S., Rose Polytechnic Institute and Ph. D., University of Pittsburgh. Dr. Fitterer has been engaged as a lecturer in the Manufacture of Steel.

The following graduate assistants have been appointed:

Chemical Engineering Department: Mr. Paul C. Helmbold, a graduate of the University of Pittsburgh, and Mr. A. L. Pope, a graduate of Carnegie Institute of Technology.

In the Department of Oil and Gas Production, Mr. H. S. Gibbs, a graduate of Pitt, has been appointed Graduate Assistant for this year.

Princeton University.—Mr. Albert C. Holt, B.S., in Engineering, who has been in the Engineering Department of the Westinghouse Electric & Manufacturing Company since his graduation from Worcester Polytechnic in 1929, has been appointed Instructor

in Electrical Engineering. He will devote his time to the course in electrical measurements and to the introductory laboratory course in electrical engineering.

During the past year the University has added a large amount of equipment to the electrical laboratory, including an oscillograph, to add to the oscillograph equipment of earlier years.

The freshman class of the present year is 25 per cent larger than that of last year and the Engineering School as a whole has an increased enrollment of 15 per cent.

Purdue University.—The total enrollment in Engineering at Purdue University shows a slight increase. While the freshman, sophomore and junior classes have not changed materially, there is a large increase in the enrollment of seniors and also a very much larger number of graduate students than ever before. The total enrollment in engineering during the present semester will approach 3,000.

Investigations have been completed in the Purdue University Engineering Experiment Station which have developed the characteristics of a steam generator at pressures as high as 3,500 pounds per square inch and temperatures of 830° F. A special automatic control for regulating the flow of water, air, and steam to boilers of this type has also been developed and the results will be presented in a paper before the American Society of Mechanical Engineers next December.

Very few changes have taken place in the staff. In fact, the turnover is very much smaller than at any time for many years. New members of the staff include the following:

Applied Mechanics, Louis Slegal, Assistant; Civil Engineering, H. A. Asperger, Instructor, H. M. Martin, Assistant, John A. Oakey, Instructor; Electrical Engineering, C. D. Endsley, Assistant, B. A. Short, Assistant, M. L. Sleeper, Instructor, G. E. West, Assistant Professor; Mechanical Engineering, D. S. Clark, Instructor, M. P. White, Assistant; Engineering Experiment Station, A. S. Gelman, Assistant, F. C. Rogers, Assistant; Engineering Extension Department, J. W. Kelly, Concrete Specialist.

Rensselaer Polytechnic Institute.—At present Rensselaer is proceeding actively with its building program. This fall the Greene Building, housing the Department of Architecture, was opened for classes. Work upon Dormitories A and B, containing ten units, is progressing rapidly. The foundation of the new Club House has also been laid, and excavation for the six units of the Church Dormitories, near the Dining Hall, has been begun. Extensive improvements have also been undertaken in a number of the present buildings. In the Pittsburgh Building a statistical laboratory has

been installed. Two biological laboratories have been added in the Proudfit Building, and in the Walker Laboratory, devoted to the Department of Chemical Engineering and Chemistry, a general stock room and a number of smaller rooms have been constructed. The increase in the facilities of the Institute has been considerable.

New instructors have been appointed as follows: In architecture, A. E. Rigg, J. G. Van Derpool; in biology, L. L. Williams; in chemical engineering and chemistry, D. T. Rogers; in civil engineering, C. O. Dohrenwend, J. S. Kenney; in drawing, A. F. Wait; in economics, C. L. Davis, F. W. Harrison, T. R. Witmer; in electrical engineering, A. M. Lockie; in mathematics, Sidney Frankel; in mechanical engineering, H. A. Wilson, H. M. Wright; in surveying, R. G. Sanders. J. G. Yenchar has been appointed assistant professor of economics.

Promotions and changes in title number four: From instructor in civil engineering to assistant professor, H. B. Howe; from assistant professor of physics to associate professor, G. A. Carragan; from assistant professor of chemistry to professor of organic chemistry, G. B. Cloke; from associate professor of architecture to professor of architectural design, R. E. Winslow.

One of the most striking developments at the Institute has been the steady growth of graduate study. This fall 74 men are registered in advanced courses. At present the number of professors giving work leading to higher degrees is 31.

Southern Methodist University.—The following teachers were added to the faculty of the School of Engineering at the opening of the fall term: R. W. Cutler, Instructor in Civil Engineering, B.S. and M.S., California Institute of Technology; Foster Rucker, Instructor in Electrical Engineering, B.S. in E.E., Southern Methodist University; Hawkins Golden. Instructor in Contract Law, LL.B., Southern Methodist University.

The summer program of **Stevens Institute of Technology** included two interesting experiments: a ten-day session for alumni, devoted to economic courses, and a two-week trial-run in engineering for preparatory school boys. Both sessions were held at the Stevens Engineering Camp in Northern New Jersey after the conclusion of the prescribed course in surveying for college freshmen.

Alumni Camp. This session, August 29 to September 7, was held under the joint auspices of the Alumni Association of Stevens and the engineering alumni of Columbia University. Seventy-seven graduates of these two colleges and of other colleges of engineering registered for all or part of the course offered. Four hours

each morning were given to a study of Corporation Finance, in charge of Professor W. D. Ennis and G. W. Barnwell (Stevens) and Ralph H. Richards (Columbia). The evenings were devoted to more informal discussion of problems related to business depression.

Camp for Preparatory School Boys. August 15 to August 29. This was an experiment in vocational or collegiate guidance, to assist boys to choose *the kind* of college for which they seem best qualified. Forty boys, juniors in high school, attended the camp. The schedule provided for four and a half hours of elementary work in surveying; two lectures daily and aptitude and psychological tests administered by Johnson O'Connor and Walter Van Dyke Bingham.

It is planned to repeat both experiments next year.

Swarthmore College.—The fall term opened at Swarthmore with a total enrollment in Engineering of 56, which is approximately the same number as we have had for the past half-dozen years. There were no changes in the faculty.

We have acquired a hump hardening furnace from the Leeds and Northrup Company, which is the principal piece of new equipment.

On November 21st will be held the fifth annual dinner meeting of Swarthmore Engineers. This is an affair held principally to bring the alumni back to visit us and has proved very successful in the past four years. These meetings are usually addressed by prominent speakers.

Swarthmore is looking forward to holding the spring meeting of the Middle Atlantic Section of the S. P. E. E. in 1932.

Agricultural and Mechanical College of Texas.—As a result of an agreement regarding the distribution of the income of oil lands, the Agricultural & Mechanical College of Texas is to receive one third of the income from the endowment built up from oil funds. The income from the endowment is available for the erection of buildings and other permanent improvements. The Legislature has recently provided that the college may borrow $2,000,000 from the fund for present building needs. This obligation is to be repaid to the fund from the annual apportionments from interest on the endowment.

Plans have been approved for a Chemistry and Chemical Engineering Building and construction is now under way. Plans are being prepared for an Agricultural Engineering building, a combined building for Petroleum Engineering, Geology and Engineering Experiment Station, and also a building for Architecture.

In addition to his duties as Dean of the School of Engineering, Dean F. C. Bolton has been made Dean of the College. M. C. Hughes, who has been Professor of Electrical Engineering, has been made Head of that Department.

Virginia Polytechnic Institute.—A graduate program in Fuel Engineering, open to graduates in Mechanical Engineering and to other qualified engineering graduates, is being offered for the first time during the session of 1931–32. This one-year course combines lecture and laboratory work with actual experience in the operation of the modern steam-electric power plant at V. P. I. There will be lecture and laboratory courses in fuels and combustion, stokers and combustion equipment, combustion control, furnaces and refractories, and power-plant records.

The Virginia Coal Operators' Association has evinced its interest in the Fuel Engineering work by supporting a fellowship to be awarded annually to a member of the graduating class. In addition, V. P. I. has established five fellowships. The group of six graduates now holding these fellowships commenced their graduate program in June.

A new type of junior college activity has been developed between the Virginia Polytechnic Institute and other colleges in Virginia. The Virginia Polytechnic Institute has accredited the work in chemistry, English, mathematics, etc., of three well-established schools and has itself retained the responsibility for the strictly engineering courses of the first two years. The Virginia Polytechnic Institute maintains its own staff for this work at the three institutions; namely, the Virginia Mechanics Institute in Richmond, the Norfolk Branch of the College of William and Mary in Norfolk, and Lynchburg College in Lynchburg. The Virginia Polytechnic Institute entrance requirements for engineering are enforced and the V. P. I. staff representatives are the Course Advisers of the engineering group of students.

The work in Richmond is directed by Professor H. S. Grenoble, assisted by Professor W. B. Harrison. In Norfolk the Virginia Polytechnic Institute is represented by Professor W. F. Harrington, assisted by Mr. A. Lee Smith, while in Lynchburg, the work is in charge of Mr. Joseph L. Ferguson.

This work was started in Richmond in 1930–31 with thirty-four freshmen enrolled, of whom twenty-seven completed the work satisfactorily. Six of these transferred to the Virginia Polytechnic Institute campus this fall and twenty are continuing their sophomore year in Richmond. The work in Norfolk and Lynchburg was started this fall.

The enrollment in engineering on October 1st was:

Graduates	35
Seniors	136
Juniors	150
Sophomores	214
Freshmen	300
Total in residence	834
At V. P. I. in Richmond	67
At V. P. I. in Norfolk	81
At V. P. I. in Lynchburg	24
Total engineering students	1,006

Dr. J. Elton Lodewick, Professor of Wood Technology, resigned in September to become Wood Technologist at the U. S. Forest Experiment Station, Portland, Oregon.

Professor J. F. D. Smith has been granted an extension of his leave of absence for another year to continue his research work at Harvard University.

Mr. B. M. Widener has been made instructor in Electrical Engineering.

Fellowships for the year have been awarded as follows: F. M. Taylor, B.S. (V. P. I.), Chemical Engineering; R. L. Selby, B.S. (V. P. I.), Chemical Engineering; C. E. Trent, B.S., (V. P. I.), Applied Mechanics; C. S. Bilisoly, B.S. (V. P. I.), Fuel Engineering; Stuart B. Row, B.S. (V. P. I.), Chemical Engineering; B. F. Moomaw, Jr., B.S. (V. P. I.), Engineering Geology; J. M. Cultice, B.S. (V. P. I.), Sanitary Engineering; L. D. Hubbard, B.S. (V. P. I.), Civil Engineering; J. R. Glenn, B.S. (V. P. I.), Electrical Engineering; W. B. Jones, B.S. (V. P. I), Applied Mechanics and Experimental Engineering; A. R. Barber, B.S. (V. P. I.), Fuel Engineering; D. C. Calhoun, B.S. (V. P. I.), Fuel Engineering; T. G. Cox, B.S. (V. P. I), Fuel Engineering; H. St. G. King, B.S. (V. P. I.), Fuel Engineering; G. A. Morris, B.S. (V. P. I.), Fuel Engineering; M. W. Moncure, B.S. (V. P. I.), Electrical Engineering.

University of Virginia.—Edwin Anderson Alderman, President of the University of Virginia since 1904, died suddenly on April 29 while en route to speak at the inauguration of President H. W. Chase at the University of Illinois.

John Lloyd Newcomb, Dean of Engineering and Assistant to the President, has been appointed Acting President of the University.

Walter Sheldon Rodman, Professor of Electrical Engineering, is now serving as Acting Dean of Engineering.

Ernest Jackson Oglesby, formerly Professor of Mathematics in charge at Washington Square College of New York University, enters upon the duties of Professor of Mathematics in the Department of Engineering and has charge of all pure mathematics instruction for engineering students.

Herman Carl Hesse, formerly at Newark Technical College, begins service as Associate Professor of Mechanical Drawing.

The University of Virginia dedicates its new Scott Stadium on October 15. When completed this stadium will be one of the finest in the South and will seat 20,000 spectators.

A large addition to the Chemical Laboratory has been opened for service this fall. Greatly increased facilities for instruction in Chemistry and Chemical Engineering are thus made available.

State College of Washington.—The new shops buildings were completed and occupied during the past summer, housing the metal working shops. Motorized equipment has been enstalled throughout the machine shop.

Dr. Paul A. Andersen has been appointed to the Headship of the Department of Physics, succeeding Dr. B. L. Steele, who passed away during the summer.

The enrollment in the **University of Wyoming** has exceeded 1,200 students during the fall term. The Engineering College likewise has the largest enrollment it has ever had. There was general surprise at the enrollment because some drop in numbers was expected. The Engineering College has passed to second place among the colleges in the University in point of four-year students.

A PROPOSED COURSE IN ADMINISTRATIVE ENGINEERING

By DEXTER S. KIMBALL

Dean, College of Engineering, Professor of Industrial Engineering, Cornell University

It is a well established fact that the majority of the graduates of engineering colleges eventually find their way into administrative positions in engineering and manufacturing enterprises. Several reasons for this tendency has been advanced. Industry is becoming increasingly scientific in its background and practices, in many cases so much so as to require technical training for an understanding of its problems. Scientific and engineering methods of thought have invaded the fields of plant location, design and operation reaching now into the personnel problems of management.

But engineers as a rule are lacking in certain qualities and accomplishments which often prevent them from attaining as high a place in industry as their opportunities offer. Many of our graduates who have been successful in administrative positions have complained that their college course did not contain certain non-technical subjects that would have been of marked value to them in industry.

The recent investigation of engineering college curricula by The Society for the Promotion of Engineering Education revealed the fact that from the viewpoint of many alumni our courses are lacking in economic and historic content. On the other hand, there is an increasing demand for more thorough scientific training for the smaller group of graduates who are to engage in engineering design and construction; and there is, therefore, greater need for retaining the present engineering degrees and making them even more significant technically, so far at least, as some options are concerned. If, therefore, a more liberal course is offered, the degree to which it leads should be differentiated from the present degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer.

The problem can, of course, be solved in a fairly satisfactory manner by five and six year courses such as are now offered by the College of Engineering as optional programs to the regular four year courses in which there is little room for liberal studies. Experience here, and elsewhere, over a number of years indicates that such courses do not attract students. If for no other than economic reasons a compulsory five or six year course in engineering seems to be expedient at this time.

The solution of the problem and the usual answer to this demand, as offered by most colleges, is a four year course in engineer-

ing with a senior option in industrial engineering, so called somewhat similar to that now offered in Mechanical Engineering in this college. These courses are liberalized with English, Economics, etc., as far as the faculties of engineering are willing to go, and yet confer an engineering degree. Of late, however, a few colleges, elsewhere, have introduced broader courses, such as the one here proposed and no doubt the tendency is in this direction.

The Faculty of the College of Engineering, therefore, wishes to establish a course in Administrative Engineering approximately as outlined in the accompanying schedules as applied to Mechanical Engineering and requests the University Faculty to approve the degree of Bachelor of Science in Administrative Engineering for the same. This degree conforms closely with practice in other colleges where such courses are offered.

Furthermore, if it becomes desirable to extend the length of the present courses to five years either to liberalize them, or to extend their engineering content, or both, it is probable that the Faculty of Engineering will wish to confer the degrees of Bachelor of Science in Civil Engineering, Bachelor of Science in Mechanical Engineering, and Bachelor of Science in Electrical Engineering at the end of the fourth year of such courses and the existing degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer, at the end of the fifth year. This is common practice in most engineering colleges in this country and is also in line with our present coöperative course in Chemical Engineering where the degree of Bachelor of Chemistry is conferred at the end of the fourth year.

The following features of the course may be noted:

(*a*) The course is an engineering course differing little from similar courses given elsewhere and leading to similar degrees.

(*b*) The entrance requirements are the same as those now required for entrance to the old courses including the higher mathematics.

(*c*) The credit hours required for graduation are 147, of which 91 are engineering or allied subjects now included in the regular four year course in Mechanical Engineering.

(*d*) The 56 remaining hours are made up mainly of courses in history, economics, finance, and similar subjects, practically all of which are now offered in other colleges of the University.

Lastly, this course is not intended to prepare men for commercial or business pursuits, but rather to prepare engineers for administrative positions in engineering and industrial life. The course is not based upon any hasty decision, but is the result of much thought upon the part of the faculty and alumni. The demand of the latter for such a course has been insistent for a number of years and the faculty believes that the new departure will

meet this need and fully justify itself. The establishment of this degree is highly necessary to the progress of the college.

Freshman Year

	1st T.	2d T.
Math. 5a and 5b	5	6
Chemistry 101	3 or 0	0 or 3
Chemistry 105	3 or 0	0 or 3
Physics 3 and 4	3	3
Elementary Drawing	0 or 3	3 or 0
Introductory Eng'g. Lab.	0 or 2	2 or 0
Introductory Lectures 130	1	0
Elementary Economics (Including Econ. History and Geography)	3	3
Hygiene	1	1
	19 or 18	18 or 19

Sophomore Year

	1st T.	2d T.	
Mechanics	5	3	Modified course
Hydraulics		2	
Empirical Design	2	0	
Kinematic Recitation	0	2	
Kinematic Drawing	0	1	
English	3	3	2 hrs. per week of business English and composition; 1 lecture per week on outstanding books of English literature
Materials 360	2	2	
Engineering Chemistry 775	2	0	
Wood Shop 102	2	0	
Foundry 300	0	1	
Business and Ind. Organization	2	2	Combination of 380 and parts of 382. Treating the business unit as a whole
Machine Shop 306	0	2	
	18	18	

Junior Year

	1st T.	2d T.	
Mechanical Laboratory 368, 369	3	3	
Machine Design Recitation	2	0	
Machine Design Drawing	2	0	
Heat Power 343 a, b	3	3	
Industrial Relations	2	0	
Accounting	3	3	New course
Money and Banking	3	0	Economics 11 as given in Arts or a new course
Corporation Finance	0	3	Present 385 modified
Business Statistics and Forecasts	0	3	New course
Public Speaking 1	0	3	
	18	18	

Senior Year

	1st T.	2d T.	
Mechanical Laboratory 372	2	0	
Electrical Laboratory 417	0	4	As given to Civil Engineers
Industrial Eng'g. Lecture	1	1	
Industrial Eng'g. Problems	2	2	
Corporation and Investment Finance	2	0	Continuation of present 385 course featuring consolidations, reorganizations and investments
Cost Accounting	0	2	New course
Business Law	2	2	New course—possibly this might be raised to 3–3
Marketing	3	3	A new course which should be developed to cover Distribution problems, Market forecasting, Advertising, Salesmanship and Sales Management
Non-Resident Lectures	0	1	
Electives	7	4	Engineering, Economic or Liberal
	19	19	

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BORGQUIST, E. S., Associate Professor of Civil Engineering, University of Arizona, Tucson, Ariz. F. C. Kelton, J. C. Clark.

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CAMPBELL, JESSE M., Instructor in Mechanical Engineering, University of Minnesota, Minneapolis, Minn. O. M. Leland, Frederic Bass.

CHILDS, WILL P., Associate Professor of Engineering, Pasadena Junior College, Pasadena, Calif. A. G. Gehrig, J. R. Macarthur.

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CULVER, EDWARD P., Associate Professor of Mechanical Engineering, Princeton University, Princeton, N. J. A. M. Greene, F. A. Heacock.

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DENUE, WILLIAM R., Professor of Civil Engineering, Manhattan College, New York City. John J. Costa, Brother D. Felix.

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FORD, ARTHUR R., Assistant Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. B. Robertson, C. F. Shoop.

FOX, LESTER H., Instructor in Electrical Engineering, Mississippi A. &. M. College, A. & M. College, Miss. L. L. Patterson, M. L. Freeman.

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HOLMES, WILLIAM M., Instructor in Electricity, Pasadena Junior College, Pasadena, Calif. A. G. Gehrig, J. R. Macarthur.

HUNT, DEWITT, Professor and Head, Dept. of Industrial Engineering, Oklahoma A. & M. College, Stillwater, Okla. P. S. Donnell, H. G. Thuesen.

KENT, HARRY L., Jr., Instructor in Mechanical Engineering, Oklahoma A. & M. College, Stillwater, Okla. G. B. Drummond, C. M. Leonard.

KIERNAN, CHARLES J., Assistant to Supervisor of Industrial Relations, Newark College of Engineering, Newark, N. J. H. H. Metzenheim, F. N. Entwisle.

KISTLER, PAUL N., Assistant Professor of Mechanical Engineering, Brown University, Providence, R. I. W. H. Kenerson, F. N. Tompkins.

LEWIS, RALPH E., Instructor in Mechanical Engineering, Texas Technological College, Lubbock, Texas. V. L. Doughtie, H. F. Godeke.

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O'CONNELL, DANIEL J., Professor of Civil Engineering, Manhattan College, New York City. Brother D. Felix, Brother Amandus Leo.

O'CONNOR, JOHNSON, Director of Human Engineering Laboratories, Stevens Institute of Technology, Hoboken, N. J. H. N. Davis, R. I. Rees.

OGLESBY, EARNEST, J., Professor of Engineering Mathematics, University of Virginia, University, Va. J. L. Newcomb, W. S. Rodman.

PANGBORN, REDMOND J., Instructor in Electrical Engineering, University of Idaho, Moscow, Idaho. I. C. Crawford, R. H. Hull.

RASCHE, WILLIAM H., Profesor of Mechanism, Virginia Polytechnic Institute, Blacksburg, Va. E. B. Norris, J. S. A. Johnson.

RICE, PHILIP X., Assistant Professor of Electrical Engineering, Pennsylvania State College, State College, Pa. E. B. Stavely, L. A. Doggett.

ROBINSON, LESLIE L., Instructor in Electrical Engineering, Worcester Polytechnic Institute, Worcester, Mass. C. A. Pierce, C. D. Knight.

SAILER, LESTER R., Instructor in Electrical Engineering, Columbia University, New York City. A. D. Hinckley, W. I. Slichter.

SOLT, MARVIN R., Assistant Professor of Mathematics, University of New Hampshire, Durham, N. H. H. L. Slobin, W. E. Wilbur.

SORENSON, ALFRED E., Assistant Professor of Mechanical Engineering, Princeton University, Princeton, N. J. A. M. Greene, C. H. Willis.

TOOLE, CHARLES E., Teacher of Physical Elements in Engineering, Pratt Institute, Brooklyn, N. Y. D. A. Isenberg, F. L. Schwartz.

WILCOX, ALFRED C., Instructor in Drafting, Pasadena Junior College, Pasadena, Calif. A. G. Gehrig, J. R. Macarthur.

WOOD, BEN D., Associate Professor and Director, Bureau of Collegiate Educational Research, Columbia University, New York, N. Y. R. I. Rees, O. W. Eshbach.

ZUFFANTI, SAVERIO, Instructor in Chemical Engineering, Northeastern University, Boston, Mass. S. A. S. Strahan, C. P. Baker.

68 new members have been added this year; 114 had been added at the same time last year. Have you asked your colleague to share with you the benefits of membership in this Society? An application blank is printed on page 174 or one may be secured from your Dean. Send application together with check for $5.00 made payable to the S. P. E. E. to the secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

MEMBERSHIP CAMPAIGN FOR 1931–32

October 5, 1931

To the Members of the Society:

Will you secure at least one new member for 1931–1932?

Last year, through the coöperation of the members, we added 235 new members to the rolls of the Society. With your assistance we can exceed that number this year. We are enclosing an application blank for your convenience and shall be glad to send you as many more as you may desire. If you need a blank before we could get it to you, ask your Dean to let you have one of his. We are sending a supply of application blanks to each Dean just for emergencies like this.

Beginning with the November JOURNAL we shall publish the list of institutions with the number of members in each and the number of applications received from each. We shall correct this each month thereafter. By this method you will be kept informed of the progress your institution is making in enrolling its staff in this Society.

The dues are $5.00 per year. There is no initiation fee and subscription to the Journal of Engineering Education is included in the dues. Have the applicant fill out the blank, make out a check for dues—made payable to the S. P. E. E.—secure two sponsors, and return this to the secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. We will then present his name to the Council for election and notify him as soon as possible. However, his subscription, if check for $5.00 accompanies the application, begins with the September number of the JOURNAL.

Trusting we may again have your coöperation, I am,

Cordially yours,

F. L. BISHOP,
Secretary.

MEMBERS IN ENGINEERING SCHOOLS AND COLLEGES

Institution	Members Nov. 3, 1931	Applications Received after Nov. 3, 1931
Akron, Univ. of	9	
Alabama Poly. Inst.	13	
Alabama, Univ. of	2	
Alberta, Univ. of	3	
Antioch College	2	
Arizona, Univ. of	8	
Arkansas, Univ. of	11	
Armour Inst. Tech.	27	
Beirut, Univ. of (Syria)	1	
Bombay C. E. College	1	
Bradley Poly. Inst.	2	
Brazil-Poly. School of State	1	
British Columbia, Univ. of	4	
Brooklyn Poly. Inst.	21	
Brown Univ.	9	
Bucknell Univ.	13	
Buffalo, Univ. of	1	
Butler Univ.	1	
Calif. Inst. Tech.	8	
Calif., Univ. of	15	
Calif., Univ. of So.	6	
Carnegie Inst. of Tech.	14	
Case School of Applied Science	29	
Catholic Univ.	1	
Cincinnati, Univ. of	6	
Clarkson College	8	
Clemson College	10	
Colby College	1	
Colorado Agri. College	6	
Colorado School of Mines	10	
Colorado, Univ. of	19	
Columbia University	28	
Connecticut Agri. College	1	
Cooper Union	14	
Cornell University	28	
Cornell College	1	
Dartmouth College	4	
Dayton, Univ. of	6	
Delaware, Univ. of	8	
Denison Univ.	2	
Denver, Univ. of	1	
Detroit University	14	
Drexel Institute	8	
Duke Univ.	7	
Duluth Jr. College	2	
Ecole Polytechnique	7	
Ely Jr. College	1	
Escuela Centrale de Ing. Ind.	1	
Evansville College	3	
Fenn College	13	
Florida, Univ. of	7	
Franklin and Marshall College	1	
Franklin Union	2	
General Motors Inst.	5	
George Washington Univ.	3	
Georgia Inst. of Tech.	15	
Gettysburg College	2	
Ghent, Univ. of	1	
Girard College	1	
Harvard University	16	
Haverford College	2	
Hawaii, Univ. of	3	
Howard Univ.	3	
Idaho, Univ. of	12	
Illinois, Univ. of	54	
Indiana Univ.	1	
Iowa State College	38	
Iowa State University	23	
James Millikan Univ.	2	
John Tarleton Agri. College	1	
Johns Hopkins Univ.	3	
Joliet Jr. College	1	
Kansas State College	42	
Kansas, Univ. of	18	
Kentucky, Univ. of	10	
Lafayette College	12	
Lawrence College	1	
Lehigh Univ.	15	
Leningrad Poly. Inst.	1	
Lewis Inst.	1	
La. Industrial Inst.	1	
La. Southwestern Inst.	2	
La. State Univ.	2	
Louisville, Univ. of	16	
Lwow, Poly. of	1	
Maine, Univ. of	21	
Manhattan College	7	
Marine Union Jr. College	1	
Marquette Univ.	10	
Marshall College	1	
Maryland, Univ. of	1	
Mass. Agri. College	1	
Mass. Inst. Tech.	45	
McGill Univ.	9	
Mechanics Inst.	2	
Mercer College	1	
Mexico, Univ. of	2	
Michigan College Mines	5	

Institution	Members Nov 3 1931	Applications Received after Nov. 3, 1931
Michigan, Univ. of	47	
Michigan State College	11	
Minnesota, Univ. of	70	
Mississippi A. & M.	4	
Missouri School Mines	10	
Missouri, Univ. of	17	
Modesto Jr. College	1	
Montana School of Mines	11	
Montana State College	3	
Mt. Allison Univ.	2	
Nanking Tech. College	1	
Nebraska, Univ. of	24	
Nevada, Univ. of	3	
Newark College of Eng.	13	
New Hampshire, Univ. of	11	
New Mexico A. & M.	3	
New Mexico School Mines	1	
New Mexico, Univ. of	3	
New York, College of City	7	
New York Univ.	18	
North Carolina State College	9	
North Carolina, Univ. of	11	
North Dakota, Agr. College	3	
North Dakota, Univ. of	4	
Northeastern Univ.	20	
Northwestern Univ.	7	
Notre Dame, Univ. of	1	
Norwich Univ.	3	
Nova Scotia Tech. College	1	
Ohio No. Univ.	2	
Ohio Mechanics Inst.	2	
Ohio State University	56	
Ohio University	1	
Oklahoma A. & M.	13	
Oklahoma, Univ. of	7	
Oregon State College	16	
Oregon Inst. Tech.	1	
Pasadena Jr. College	4	
Pei Yeng Univ.	2	
Penna. Military College	2	
Penna. State College	37	
Penna., Univ. of	15	
Philippines, Univ. of	1	
Pittsburgh, Univ. of	26	
Porto Rico, Univ. of	3	
Pratt Institute	33	
Princeton University	12	
Purdue University	87	
Rensselaer Poly. Inst.	13	
Rhode Island State College	5	
Rice Institute	7	
Rindge Tech. School	1	
Riverside Jr. College	1	
Robert College	5	
Rochester, Univ. of	3	
Rose Poly. Inst.	9	
Rutgers Univ.	14	
St. Thomas, College of	1	
Santa Clara, Univ. of	1	
Saskatchewan, Univ. of	2	
South Carolina, Univ. of	1	
South Dakota School Mines	11	
South Dakota State Coll.	2	
South Dakota, Univ. of	3	
Southern Methodist Univ.	5	
Stanford University	14	
Stevens Inst. Tech.	13	
St. John's Univ.	1	
Swarthmore College	6	
Syracuse Univ.	14	
Tangshan Univ.	1	
Tennessee Poly. Inst. of	2	
Texas Agri. College	2	
Texas A. & M.	24	
Texas College of Arts	1	
Texas College Mines	1	
Texas Tech. College	14	
Texas, Univ. of	12	
Toledo, Univ. of	4	
Toronto, Univ. of	9	
Trinity College	1	
Tufts College	18	
Tulane University	9	
Tulsa, Univ. of	1	
Union College	11	
U. S. Military Academy	3	
U. S. Naval Academy	7	
Utah Agri. College	2	
Utah, Univ. of	9	
Valparaiso Univ.	1	
Vanderbilt University	5	
Vermont, Univ. of	10	
Villanova College	1	
Virginia Military Inst.	7	
Virginia Poly. Inst.	15	
Virginia, Univ. of	13	
Washington State Coll.	9	
Washington Univ. (St. Louis)	13	
Washington, Univ. of	16	
Wentworth Institute	5	
West Virginia Univ.	10	
Wisconsin, Univ. of	35	
Worcester Poly. Inst.	27	
Wyoming, Univ. of	7	
Yale University	38	

Return to the Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Society for the Promotion of Engineering Education

Date.....

THE UNDERSIGNED desiring to become a member of

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

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EARNINGS OF LAND GRANT COLLEGE ALUMNI AND FORMER STUDENTS *

By DONALD S. BRIDGMAN

American Telephone and Telegraph Company

General

As college enrollments, since the war, have rapidly increased, the earnings of college men have become a subject of decided interest to both educators and laymen. Comprehensive and reliable information concerning them, however, has been rather scarce as most of the figures published relate to the graduates of single institutions and even single classes. The number of cases is usually small and the sampling is often not representative. Undoubtedly, the best available data are those collected by the Society for the Promotion of Engineering Education in 1924 and by the American Society of Mechanical Engineers in 1930 but these, of course, cover only engineering graduates.

During 1928, however, the United States Office of Education, in connection with its survey of the Land Grant Colleges and Universities, obtained over 37,000 replies to its questionnaire addressed to their alumni and former students. This questionnaire included, with many other items, data concerning each former student's year of matriculation, whether or not he graduated, curriculum pursued, present occupation, and annual earnings obtained from it at intervals since leaving college. From these data many significant studies of earnings in relation to amount and kind of college training and present occupation can be made. The former students of the Land Grant Colleges and Universities, moreover, constitute a thoroughly representative group of American College men and women. There are 52 of these institutions, located in every state, Hawaii, Alaska, and Porto Rico, with a 1927–28 enrollment in degree courses of nearly 200,000. About half of them are state universities; the remainder are separate colleges of agriculture and engineering.

The Office of Education report of the Land Grant College Survey (Bulletin No. 9, 1930) presented only one aspect of the many earnings studies which were possible, namely, the present earnings of graduates on the basis of their occupation. No analyses

* Presented in part at Industrial Conference, Pennsylvania State College, May 15, 1931.

were attempted of past earnings, those of graduates from the several principal curricula pursued, or those of non-graduates.

As such further analyses seemed likely to yield valuable results, the Engineering Foundation, on the advice of its Education Research Committee, undertook them, and is presenting the results in this article. Its analyses relate only to the men included, as this is in keeping with the Foundation's purpose, and studies for the women have been made by the Institute of Women's Professional Relations. To determine the scope of its work, the Foundation first examined the original questionnaires received from four institutions, but the final analyses were made from copies of the tabulating cards prepared by the Office of Education.

For the opportunity to undertake this work, the Foundation is, therefore, greatly indebted to the Commissioner of Education, Mr. W. J. Cooper. It also wishes to acknowledge the help of the Emergency Work Bureau of New York City, which furnished six clerical workers for the preliminary studies, and that of Columbia University in providing space for this work. In his plans for the project, the author consulted with Director A. D. Flinn of the Foundation, President H. N. Davis of Stevens Institute of Technology, Chairman of the Education Research Committee, and Colonel R. I. Rees of the American Telephone and Telegraph Company, and gratefully acknowledges their assistance.

The Material Used

Of the 37,000 replies received by the Office of Education, about 31,000 were from men, and were used in the Foundation's study. As Figure I indicates, questionnaires were sent to the matriculants of three classes in each ten-year period, *e.g.*, those matriculating in the college years of 1889–90, 1890–91, and 1891–92. The men replying were classified in three groups, (1) graduates of the

Fig. 1

Number of Replies from Men Available, Graduates and Former Students of Land Grant Colleges

Years of Matriculation	Graduates [a]	Graduates [b]	Non-Graduates
1889–1891	1,147	112	515
1899–1901	2,525	244	1,080
1909–1911	5,714	558	2,051
1919–1921	9,978	1,985	5,040
Total	19,364	2,899	8,686

[a] Of original institution and course.
[b] Of another institution or course.

institution and curriculum in which they first enrolled, (2) men who transferred to some other institution or curriculum but obtained degrees, and (3) men who failed to graduate.

Because the number of women who received the questionnaire is uncertain, the exact percentage of return from the men is not available but, in general, it appears to have been about 60 per cent for the graduates and about 35 per cent for the non-graduates. About 90 per cent of the replies from graduates and 75 per cent of those from non-graduates contained substantially complete earnings information. Such information was received, therefore, from about 55 per cent of the graduates who probably received the questionnaire and from about half as large a percentage of the non-graduates.

For the graduates, this percentage of return is distinctly larger than is usually obtained from a questionnaire and should give a reliable sample of them. In the case of this particular questionnaire, too, there seems somewhat less likelihood than usual that it was mainly the successful individuals who replied, since many questions entirely unrelated to earnings were asked before the one concerning them was reached.

For the non-graduates, there is much less assurance that the returns represent the entire group. Not only was the percentage of return much less but it is probably the relatively unsuccessful non-graduates who have lost touch with their colleges and would be unlikely to reply to a questionnaire of this type.

The Methods Employed

In the charts presenting earnings, medians, and not averages, have been used, supplemented in many of them with the medians of the men whose earnings placed them in the upper and lower halves of the group. Median earnings for a group of men are those of the middle man in the group, for example the 50th man in a group of 99 and are usually much more representative of the whole group than average earnings which may be greatly affected by a small number of men with very high earnings. These particular data, moreover, merely stated in which of such ranges as $2,000–$2,999, $3,000–4,999, $10,000–19,999, each man's earnings stood at a given time. In calculating averages from such data, it is usually assumed that actual earnings for each man in the ranges given were $2,500, $4,000, or $15,000. In calculating medians, no assumptions of this sort are necessary for any range except that in which the median actually lies. As a result, the average for graduates 30 years out of college in the general report (Vol. 1, p. 381, table 43) calculated with the assumption cited is $8,375, the median (Fig. 2 following) is just about $6,000.

In locating medians from the data available for each distribution, which give the number of cases within such ranges as those shown above, it has been assumed that all cases within the range where the median lies are equally spaced. This is the simplest method and, in this case, seemed to give quite accurate results, when checked by the method of locating the 50 per cent point on cumulative percentage curves drawn on special graph paper.

It must be recognized, however, that medians found by such methods are approximations and, in addition, are subject to sampling errors, whose magnitude depends directly on the dispersion of the earnings reported and the number of cases available. For example, 868 graduates who matriculated in 1889–91 reported earnings at 30 years after graduation. The median of these earnings was $6,050, the median of their upper half was $10,600, of their lower half $3,860, and the probable error of the median, in the technical sense, was about $145. This signifies, that if a large number of samples with the number of cases shown were selected from the group giving this sample, the medians of half of them would be expected to lie within the limits, $6,050 $\pm$ 145.

This probable error is the largest occurring at any point for the whole group considered in this study. When that group is divided into sub-groups by type of training, etc., substantially larger probable errors occur. On this account, apparent differences between the median earnings of those sub-groups may be due only to the particular samples available and may not indicate real differences in the groups from which they came. It is possible, however, to determine the mathematical probability that the differences found are significant and this probability is noted in the following discussion where it affects the conclusions to be drawn from certain data.

In carrying out the several analyses which follow, certain other problems of method presented themselves because of the character of the data available. These, however, will be discussed in connection with the analysis involved.

Past Earnings of Graduates

Figure 2 shows the actual median earnings of each group of classes studied since its graduation until about the end of 1928, except the earliest group which reported its earnings 30 years out as of 1923–25. Table 2a at the end of the article gives the actual figures from which this chart was prepared, the medians of the upper and lower halves of the groups covered, and the number of cases available. Similar tables for each of the following charts are also given there.

These groups of graduating classes, of course, correspond with the matriculation groups shown in the first column of Figure 1. *i.e.*, the classes matriculating in 1889–91 graduated in 1893–95, etc., from their original institutions and course. Each man was asked to report his earnings for the 1st, 2d, 5th, 10th, etc., years after graduation but it seems clear that these instructions were not interpreted strictly and to plot the points as of ½, 4½, etc., years after graduation would introduce an artificial degree of refinement. They have, therefore, been plotted as shown here in all the charts.

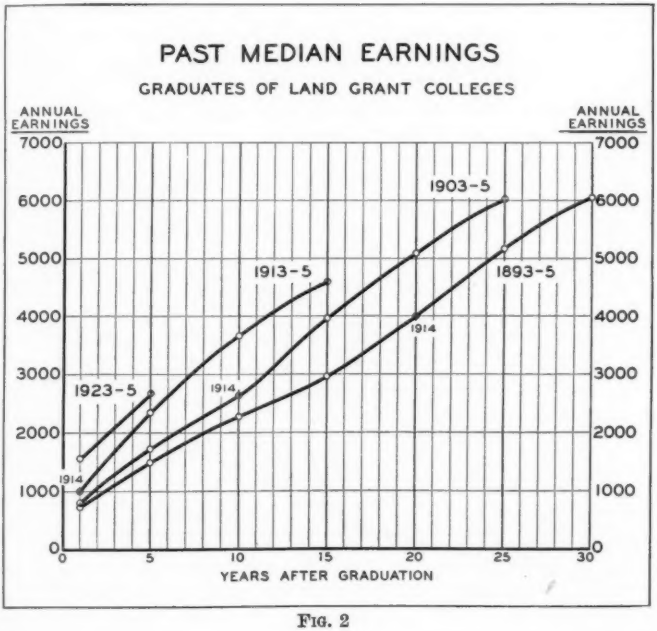

FIG. 2

The slope of each of these curves has undoubtedly been influenced by two factors, the increasing maturity of the men and rising salary levels during the period covered. The influence of the second factor may be seen by comparing the points on each vertical line, which give the median earnings of groups of classes, ten years apart, the same number of years after graduation. It has not, however, affected each class group equally, as may be seen by comparing the curves immediately after the year 1914. At that

time, the men graduating in 1893–95 were on the average 20 years out of college and salary standards at the level they had attained changed so slowly that the slope of their curve was practically unchanged. Without some change in those standards, however, it might have tended to flatten out. For the men of the 1903–05 classes, a sharp rise occurred after 1914, and the progress in earnings during the first ten years of experience for the men graduating in 1913–15 was very much greater than that of the earlier classes. The 1923–25 men during their first five years, however, show less rapid progress as salary standards again stabilized.

Figure 3 shows the trends of college graduates earnings on an index number basis with 1914 as 100, from 1904 to 1928 and com-

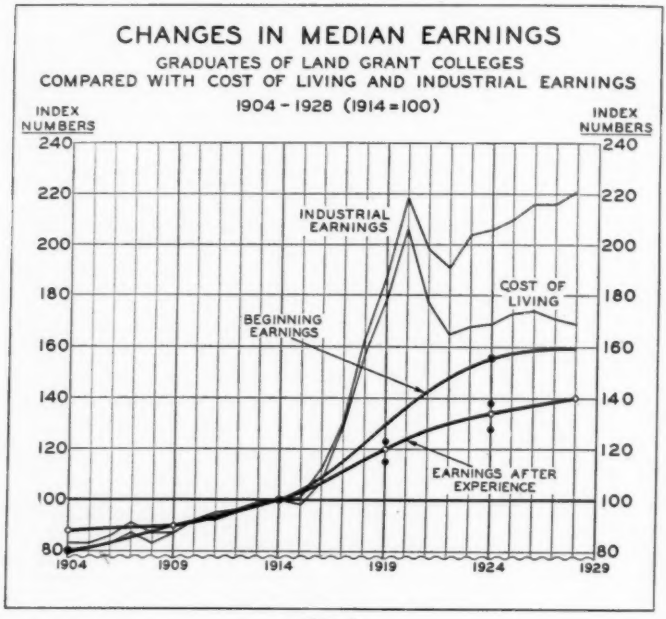

FIG. 3

pares these trends with those of the cost of living and general industrial earnings as given in Professor Paul H. Douglas' book, "Real Wages in the United States." As rather different trends were found for beginning or first year earnings and those of men with experience, two curves were constructed, one based entirely on first year earnings and the other on the average trend found for men 5, 10, 15 and 20 years after graduation.

As is shown by the points plotted in these curves, actual data were available only every 10 years for the beginning earnings and only every 5 years for those of men with experience. Both curves, therefore, and particularly the former, are undoubtedly smoother than if more complete data had been used although it is generally acknowledged that the changes in these earnings are distinctly gradual.

The beginning earnings curve was extended beyond 1924 not on the basis of actual data from the Land Grant Survey but other available information which made it clear that little change had occurred since that date although a slight upward tendency was discernible. This curve, of course, shows more total change than that of the men with experience and more sensitiveness to other economic trends. As was to be expected there is evident from the latter curve a pronounced lag behind other changes in the value of the dollar, in the earnings of college graduates with experience. The solid dots above and below that curve indicate, too, that the extent of this lag is dependent somewhat on the maturity of the men. The dots above the curve indicate the trend for men of about 5 years' experience, and show that a curve drawn through them and the common final point would be almost flat from 1924 to 1928. The dots below the curve indicate the trend for men of 15 or 20 years' experience and show that earnings standards for them were still upward at that time.

Of course, most of these earnings were salaries although the earnings of professional men and owners of businesses are included, and it is well known that salaries, as compared to wages, do not change nearly as rapidly nor as much. In fact, it may be quite unfair to compare an index of college graduates' earnings, which are mainly salaries, with an index of industrial earnings, which are primarily wages, or even of the cost of living. Certainly, to draw sweeping conclusions from such a comparison would be unwarranted. Unfortunately, the indices of industrial earnings and the cost of living represent the most nearly comparable data which are available and no satisfactory index of salaries has been constructed. The United States census of manufactures, however, has reported average salaries in manufacturing industries since 1909 but they include the earnings of many clerical workers and other relatively low-paid employees and are hardly representative of executive and staff salaries, as in 1927, the average was only $2,480 per year. This figure represents an index of 188, with 1914 as 100, but what the index would be for men in all occupations holding positions comparable to those held by college graduates is simply not known.

Nevertheless, the chart and this information does give some evidence that college graduates have not maintained their relative

economic status during the last 25 years, although the extent to which they have failed to do so, especially in comparison with other men in similar positions, is certainly obscure. This probably was inevitable, as during the interval the proportion of the young men graduating from the colleges has more than doubled and many men now attending them do not have the natural advantages of family and social position which were almost characteristic of the college man of 1900. The number and sort of men, who, in the future, can hope to realize economically on a college education remains an unanswered question.

Latest Earnings of Graduates

Figure 4 shows the latest available median earnings of the whole group of graduates and of its upper and lower half. The median

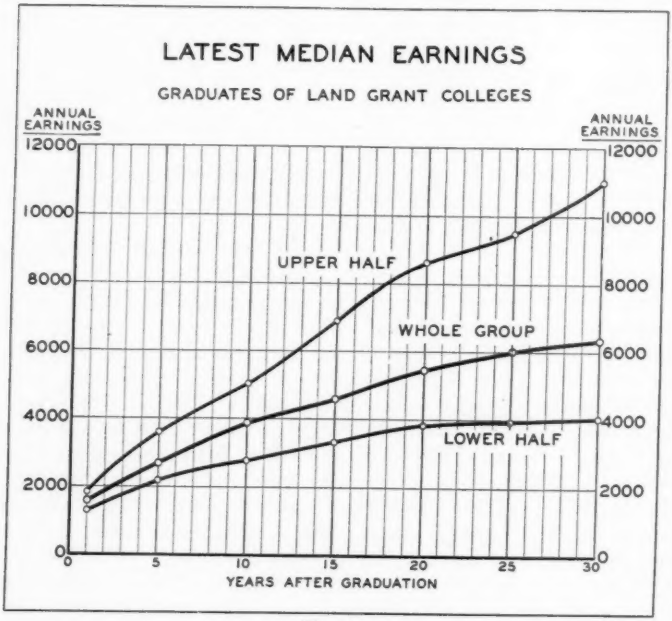

Fig. 4

of the upper half, of course, is the lower limit of the highest 25 per cent of these men and that of the lower half is the upper limit of the lowest 25 per cent.

In developing the data for this chart, one difficulty became evident which can be explained best by considering the material avail-

able for it from the 1903–05 classes. As these men sent in the questionnaires late in 1928 or early in 1929, 25-year information as of about that time was furnished only by the 1903 graduates and certain 1904 men who at least approximated it. These same men furnished 20-year information as of about 1923. All the 1905 and many 1904 men, however, felt unable to give 25-year information and the latest figures from them were 20-year figures as of, on the average, early 1925.

Now, the significant point which developed from this was that the 20-year median earnings for the group which did not give 25-year figures were $700 higher than the corresponding median for those who did give 25-year information. This difference is in part due to rising earnings standards during this period as the lower 20-year figure was as of roughly 1½ years before the higher one. No such rapid change in those standards was then occurring, however, and the difference must also be partly due to a tendency to overstate 20-year earnings in those men unable to give 25-year information, perhaps by giving earnings not strictly for the 20th year but for a little later date.

If this assumption is sound, it seems to destroy to some degree the reliability of the 20-year figures. On the other hand, due to rising standards, actual 20-year earnings in 1928 were above those in 1925. Since the 25-year information was as of 1928, it is not wholly unfortunate that 20-year figures given as of 1925 seem to have been somewhat inflated.

A similar situation is found at the 1- and 5-year points obtained from the 1923–25 group and the 10- and 15-year points from the 1913–15 one. In the latter group, there was a $500 difference in the 10-year median earnings between the men who did and did not give 15-year figures but in the former one, the difference in the first year median earnings between those who did and did not give 5-year figures was only $20. Standards at this point, however, did not change from 1925 to 1928.

As 30-year information was the last requested from the 1893–95 graduates, this group did not split into two parts and only figures for the entire group as of 1924 are available. It seems reasonable to believe, however, that the same influences which affected the 1913–15 group at 10 years and the 1903–05 group at 20, would have caused a similar spread between the figures obtained for corresponding parts of this group. If the 30-year figures are to be comparable, therefore, to the later ones obtained at 10 and 20 years those for the whole group should be raised about 5 per cent. This is distinctly arbitrary but the resulting figures are certainly more comparable with those for the other classes than if no such adjustment were made. Even this in no way compensates for the

fact that the 1893–95 graduates obtained the benefit of rising earnings standards much less than did the later groups.

To sum up this rather involved discussion, the 5-, 15-, and 25-year points on Fig. 4 are as of 1928 and based on all men giving such information; the 1-, 10-, and 20-year points as of 1925 and based only on those men who did not give later information. They seem, however, to have been inflated enough to compensate for the rising standards during the interval. The 30-year point as of 1924 has been made comparable by an arbitrary increase of 5 per cent. It is surprising, perhaps, to find the resulting curves so smooth and, despite the discrepancies in the data, it is believed that they give, within small limits, an accurate picture of the earnings of this group of graduates as of about 1928.

These difficulties do not involve comparisons between any of the charts showing the "Latest Median Earnings" of groups of graduates as the same methods have been used in preparing all of them. In Fig. 2 giving the "Past Median Earnings" all data given by the men in each group of classes were used at every point.

The men whose earnings are shown in Fig. 4 include, of course, men who pursued quite different curricula at college and who now are in a wide variety of occupations. As a background for the following charts concerning the earnings of these sub-divisions of the whole group, Fig. 5 shows their general distribution by years of graduation, type of training, and present occupation.

In the second table, these men have been classified into one of five broad types of occupation. In this classification, business includes all men in any type of business or industrial pursuit including even professional engineers, since the great majority of them are employed by business organizations. In education are included not only teachers, but men in research, extension, inspection and regulatory positions in schools, colleges, or Government Departments, and similar publicly supported institutions. Men holding research positions in business organizations, however, were classified as in business. The professional group includes mainly ministers, lawyers, physicians, and dentists. Those in farming include farm and ranch operators, superintendents, or laborers. Men in none of these occupations were classed as "Other." The aim in this classification was to set up a limited number of groups in which the earnings standards were reasonably homogeneous, although there would inevitably be some variations by classes of occupation within them.

In most of the remaining charts, broken lines instead of curves have been used, since the limited amount of data sometimes available has resulted in substantial irregularities in the points found. Smoothed curves might easily give a false impression of reliability.

Fig. 6. shows the latest median earnings of the graduates in the professions, business, education, and farming. The median for men in "Other" occupations is not shown, to avoid complication in the chart and because it is rather a hybrid group. The differences found between these earnings are about as expected, except

FIG. 5

DISTRIBUTION TABLES,
GRADUATES OF LAND GRANT COLLEGES

Years of Graduation

	1893–95	1903–05	1913–15	1923–25	Total
Number	1,147	2,525	5,934	9,962	19,568
	Percentages				
Type of Training:					
Engineering	54.3	66.4	45.3	49.1	50.5
Agriculture	15.6	10.8	32.2	27.3	25.9
Arts and Science	23.6	17.1	11.6	14.7	14.7
Other	6.5	5.7	10.9	8.8	8.9
Total	100.0	100.0	100.0	100.0	100.0

Type of Training

	Engrg.	Agric.	Arts and Sci.	Other	Total
Number	9,882	5,084	2,853	1,749	19,568
	Percentages				
Occupation:					
Business	85.0	30.1	36.5	47.1	60.2
Education	9.4	43.8	21.1	26.1	21.6
Professional	2.6	3.7	31.3	8.9	7.7
Farming	1.0	17.8	1.8	1.6	5.5
Other	2.0	4.6	9.3	16.3	5.0
Total †.	100.0	100.0	100.0	100.0	100.0

possibly the advantage of the professional men over those in business. This advantage is statistically significant at 10, 15, and 20 years out of college, but their advantage at 25 years, and disadvantage at 30 years may easily be due to sampling. This may also account, at least in part, for the drop in their median between 25 and 30 years.

Both the curves for the men in business and in education are based on a large enough number of cases to determine each point rather exactly, with the possible exception of the 30-year one for education. It is, of course, difficult to measure accurately the financial returns of men engaged in farming, and the number of cases available giving data at 20 years or more after graduation is small. The figures shown, however, confirm the general impression concerning this occupation. It will, of course, be recognized

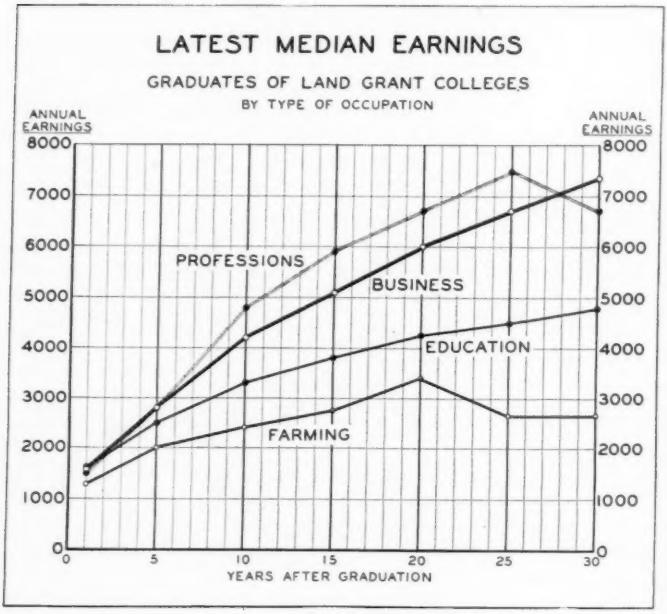

FIG. 6

that money earnings are an inadequate measure of the total rewards of men in different vocations. Certainly many of the men in education and farming chose these occupations for reasons quite apart from the expected monetary return.

Quite different figures might well have been obtained for men in each of these occupations, if they had been based on men now residing in certain parts of the country. To bring out the general magnitude of such geographical differences, Fig. 7 shows medians for all men, and for those in the upper and lower halves of their groups, who are in business and now residing in the industrial

north-east or the south and west. In it, the industrial north-east embraces all states north of the Potomac and Ohio Rivers, including Maryland and the District of Columbia, but not West Virginia, and east of the Mississippi except Wisconsin. The south and west includes the remainder of the country. Men in business only are covered as they show the most striking differences and constitute the largest group.

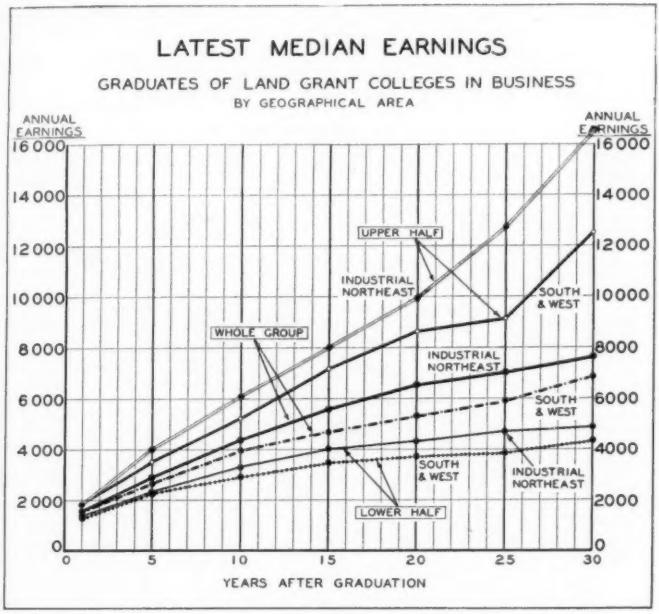

FIG. 7

The geographical differences found here are rather substantial, particularly those characteristic of the upper half of the group. They do not, however, account for differences found on the basis of college training, which is next discussed, because generally those are found for each area as well as the entire country.

Fig. 8 shows the median earnings of graduates who pursued different curricula in college. It brings out one or two rather noteworthy things. As would be expected from the fact that 60 per cent of the agricultural graduates are in either education or farming, their median is decidedly the lowest. The median for the men grouped as "Other" is significantly lower than those for the

engineering and arts and science men at 10 to 20 years after graduation, but from 20 years out its exact location is somewhat indeterminate due to a relatively small number of cases. Its rise is not caused wholly by sampling but the exact reason for it is not evident.

The curve for engineering graduates shows a steady upward trend. It is based on a relatively large number of cases, not less than 500 at any point, of whom the great majority are in business occupations. The curve of the arts and science men, on the other hand, rises most sharply of all up to 15 years out of college but be-

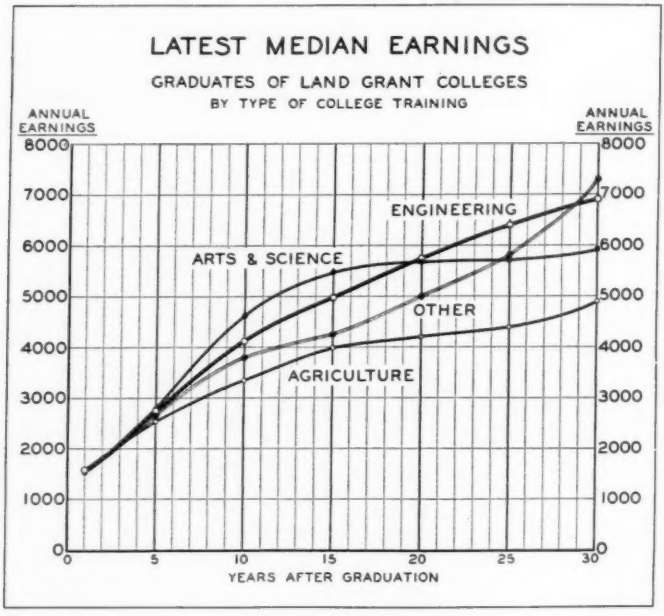

FIG. 8

yond that it is almost flat. The number of cases at each point, moreover, is at least 150 and the proportion of these men in business and the professions does not change appreciably. About a third of these men are in education, farming and other relatively low-paid occupations, the great majority of them well below this median beyond 15 years after graduation, and this undoubtedly affects it substantially. At 30 years out, moreover, an actual drop in the median for these graduates in business and the professions occurs. At any rate, an analysis of the two curves reveals that the

advantage of the arts and science men at 10 and 15 years out is thoroughly significant from a statistical point of view while that of the engineering graduates at 25 and 30 years is equally so.

Probably a more valid comparison of the earnings of men graduated from different college curricula is one which compares their earnings in the same occupation. This material furnishes sufficient data to do this only in the field of business. The results are shown in Fig. 9. In it, the "Other" group is relatively small, particu-

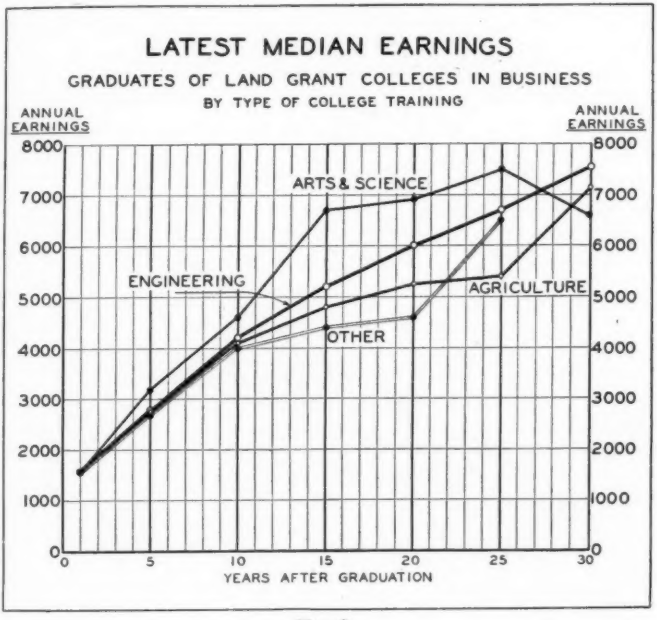

FIG. 9

larly after 20 years out of college. In fact, no median is shown for it at 30 years out as data for only 11 cases were available there. In the same way, the number of cases on which each of 20-, 25-, and 30-year points was determined for the agricultural graduates, was less than 40. In general, however, it is not surprising that men with these types of training, especially beyond 10 years out of college should lag behind the engineers and arts and science men in business occupations.

As between them, the advantage appears to lie rather strikingly with the arts and science group. This advantage, moreover, is

thoroughly significant from the statistical view-point from 5 to 15 years after graduation. Considering the number of cases involved, it may easily be due to chance at 20 and 25 years. The advantage of the engineering graduates at 30 years, however, is somewhat but not highly significant.

To identify the reasons for this advantage is a complex problem involving a number of unknown factors. It seems best to postpone discussion of it until the remaining material has been presented.

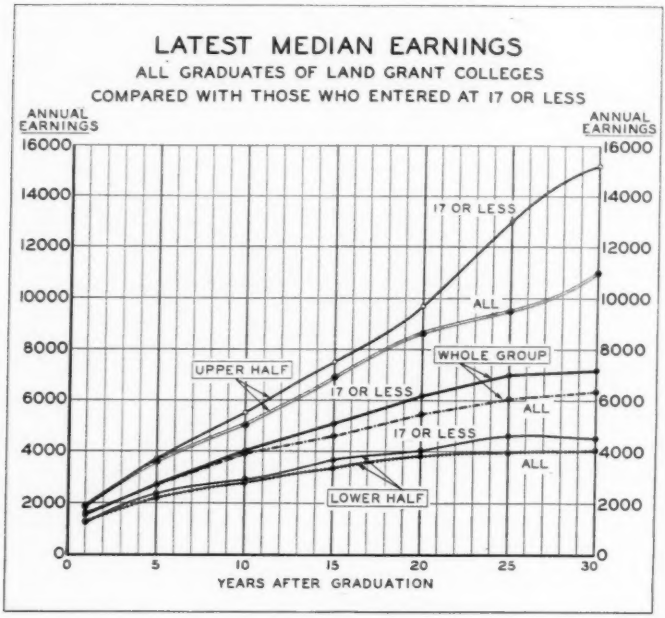

FIG. 10

The last chart compared the progress of these men on the basis of type of college training received. A somewhat similar comparison on the basis of their intellectual capacity would be most interesting. Valid data concerning capacity are rare at best and certainly not available in this material. An attempt, however, has been made to segregate a group of men whose capacity may be assumed to be above that of the entire number. This is the group of graduates who entered college at 17 years of age or less, roughly 19 per cent of the whole. Fig. 10 shows the median earnings of this group, and its upper and lower halves as compared with those

of all the graduates studied. The differences it brings out indicate a decidedly significant advantage for the younger men at and beyond 15 years out of college. At the start their earnings are slightly less than those of the whole group but at 5 and 10 years out they reach and pass those earnings.

Similar differences in favor of the younger men were found in a study of the men in business occupations only, but a chart covering it would add little to Fig. 10.

Further analysis of the earnings of men entering college at various ages might be well worth while but it seems beyond the scope of this article. The comparison already shown, however, clearly indicates that superior native intellectual capacity, even when differentiated by so crude a method as age at entrance to college, plays a very substantial part in future success.

Latest Earnings of Post-Graduates

Of the group of graduates whose earnings have been discussed thus far nearly 30 per cent have also had some post-graduate training. The available data do not indicate the field in which that

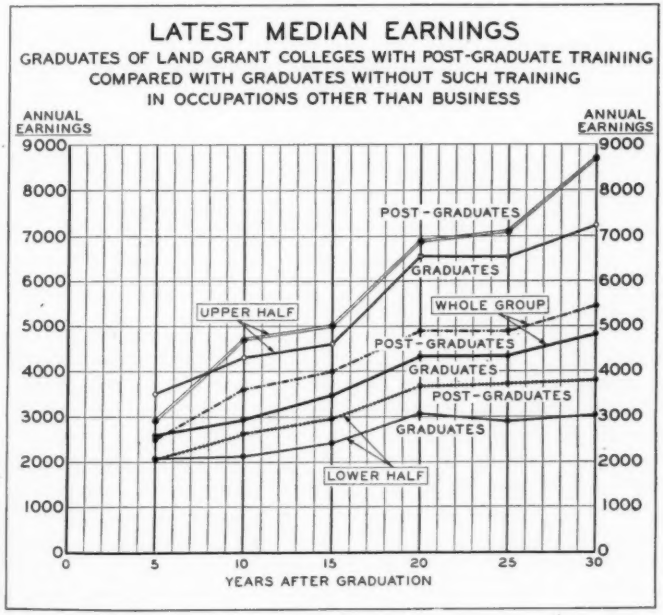

Fig. 11

training was obtained but the length of time spent on it was tabulated in the U. S. Office of Education report. This time varied from one year or less with no degree in the case of something over 40 per cent of the group, to the time necessary to obtain the degree of Doctor of Philosophy in the case of about 5 per cent. About 40 per cent received Masters' degrees.

Comparison of the earnings of all the men having post-graduate training with those of the entire graduate group indicates some advantage for the latter. This is at first surprising but it seems to be due entirely to the fact that only about 30 per cent of the post-graduates are in business as contrasted with 60 per cent of all the graduates. In fact, in business, the median earnings of the graduates and post-graduates are almost exactly the same, and in occupations other than business, as shown by Fig. 11, there is a significant advantage for the post-graduates over the men without that training. This does not assert itself until 10 years after graduation, probably because of the shorter experience of the post-graduates, and no comparison at all is possible for the first year when they are still in college. This advantage is wholly logical as in teaching and the professions their added training should be of distinct value.

Latest Earnings of Graduates Who Changed Institutions or Curricula

Up to this point, the entire discussion of earnings has been based on those graduates furnishing information who received degrees in the institution and curriculum in which they first enrolled. Fig. 1, however, indicated that questionnaires were also sent in by nearly 3,000 men who received their first degrees only after transfers to other institutions or curricula. Some 80 per cent of these men furnished earnings information and a brief general discussion of them seems desirable.

On the whole, the median earnings of these men are somewhat above those of the graduates without transfers but the differences are statistically significant only at 10 years after graduation. If members of the two groups now engaged in business are compared, once again the advantage lies with the men who changed their courses, particularly at 10 and 15 years out. A distinctly smaller percentage of these men than of the original group, however, is in business, 40 per cent as compared with 60 per cent, and 28 per cent, instead of about 7 per cent, are in the professions. Although complete data concerning their college training are not available, therefore, it appears that many of them transferred from general courses into those in law, medicine, etc. Possibly further analysis

of their earnings in the professions and other specific occupations would be worth while and, despite the small numbers involved, they might bring out some significant factors. This seems to be beyond the scope of the present study, however, and the only conclusion now warranted is that these men have certainly been no less successful than those who have completed their college course without a transfer.

Latest Earnings of Non-Graduates

In addition to the two groups of graduates, whose earnings have now been discussed, Fig. 1 shows that questionnaires were returned by some 8,700 non-graduates of these institutions, of whom about 75 per cent gave recent earnings information. As already pointed out, the men furnishing such information were less than 30 per cent of the number probably receiving questionnaires. This contrasts with a ratio of 55 per cent of the graduates and makes it quite certain that a far less representative sample of the non-graduates' earnings is available.

This impression is confirmed by the fact that, as shown by Fig. 12, the earnings of non-graduates who entered college at 17 or less, a criterion which proved definitely selective for the graduates, are little if any higher than those of all the non-graduates. A plausible explanation of this is that the entire group was determined by other special factors, equally selective with early entrance to college.

The methods used in constructing Fig. 12 were necessarily somewhat different from those used in dealing with the graduates' earnings. In the first place, as indicated by the data from a few representative institutions, these men spent, on the average, only about two years in college and the most convenient basis on which to show their earnings is years after matriculation, since this basis can also be used for the graduates as in the next chart. Earnings furnished for the first, fifth, etc., years after leaving college then, become earnings for the third, seventh, etc., years after matriculation.

In the second place, because of their relatively short time in college, no such difficulty in giving up-to-date earnings faced the non-graduates as was met by the men graduating in 1905, 1915 and 1925, who were unable in 1928 to give earnings for their 25th, 15th or 5th years after graduation. In fact, the only non-graduates unable to give such earnings were men in these classes who had spent over two years in college. Consequently, it was impossible to use information for the 1st, 10th and 20th years out of college based only on men failing to give later information and all the returns for these years from the appropriate classes were used. This,

together with the fact that these men, on the average, spent only two years in college, means that the data for 3d, 12th, 22d and 32d years after matriculation are as of about 1923, and those for the 7th, 17th and 27th years after are as of about 1927. The absolute levels of the medians given, therefore, do not represent the present situation and cannot be compared with the graduate earnings already shown, but comparisons between two groups of non-graduates as shown in Fig. 12 are entirely valid.

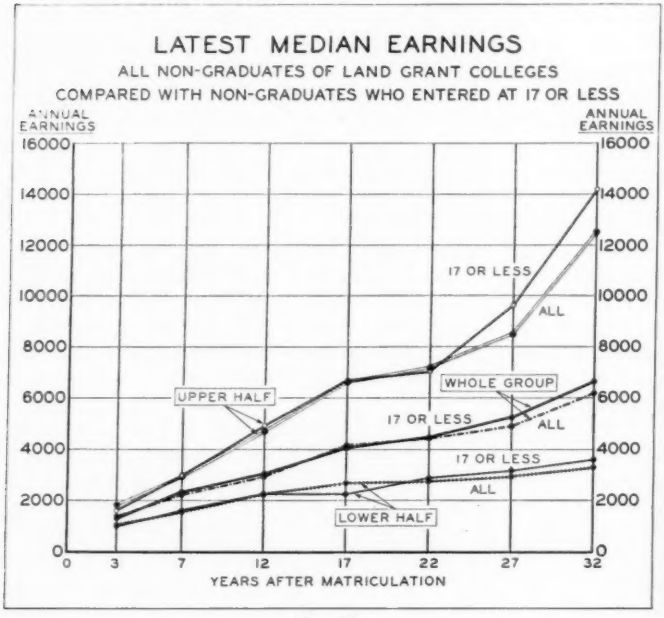

FIG. 12

Because it seems clear that the samples are not equally representative, no chart comparing the median earnings of the entire group of graduates and non-graduates has been included. Such a chart, if constructed on the data available would show a small, but quite insignificant, advantage for the graduates. A fairer comparison, however, appears to be that shown in Fig. 13 which gives the earnings of those graduates and non-graduates who entered college at 17 or less. Similar methods have, of course, been used in compiling the data for both these groups and the comparison is of earnings for the same calendar year, up to which the graduates

have usually had two years less experience, as they spent two years more in school. Some interpolation from the data actually available for the graduates was necessary to accomplish this but it is believed the resulting figures are substantially accurate.

In this chart, no earnings are given for the graduates during the 3d year after matriculation as they were still in college. At the 7th year, when they have been out 3 years and the non-graduates 5 years, they have not yet overcome the handicap of their

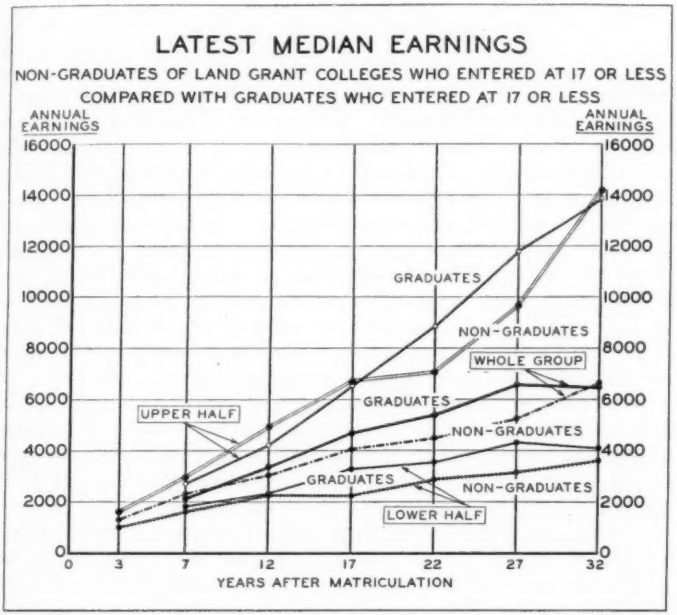

FIG. 13

later start, but beyond that, except at the 32d year, the graduates' median is substantially and, from a statistical point of view, significantly higher. At the 32d year, the probable errors of both medians are distinctly larger than the difference between them and, with different samples, their relative positions might easily have been reversed.

In the lower halves of the two groups, the advantage of the graduates asserts itself earlier and, considering the level of earnings shown, it is more striking than for the whole group. This seems natural as the men with the most unfavorable traits in the great majority of cases would fail to graduate. The more success-

ful non-graduates, on the other hand, maintain their initial advantage over the graduates a bit longer than does their whole group.

On the whole, it probably cannot be said that these two groups are equal in native ability, but since both are made up of men able to enter college below the average age, they should approach one another in this respect. The generally better progress of the graduates, therefore, affords some measure of the value of their additional training.

Summary and Conclusions

Much of the data presented in this article leads to conclusions which are almost obvious although definite representative figures confirming them are of value. This is true of the data concerning earnings of graduates in different occupations and in different parts of the country. It would certainly be expected, also, that in occupations other than business, mainly the professions and teaching, the earnings of men with post-graduate training would surpass those without it. That post-graduate training should not appear as an advantage in business is perhaps less obvious but hardly surprising. In general, moreover, the actual earnings shown for the whole group of graduates confirm the findings of other similar studies although they do not approach averages reported by the reunion reports of certain college classes.

More interesting are the data concerning men graduated in different decades and different curricula, particularly those comparing Arts and Science and Engineering graduates now in business, the data concerning those graduates who entered college at 17 or less, and those concerning the non-graduate group.

The comparison between Arts and Engineering graduates now in business does give some quantitative evidence bearing on the recurring question of the relative values in cultural and technical training. Apparently, from the economic point of view, where technical training is thought to have its strongest case, the advantage actually lies with Arts and Science or cultural training. For a conclusive case, however, much more analysis would be necessary and even with that it might not be proved. It is certain that the geographical distribution of the two groups did not influence the result, but one or more of many other variables may have done so. Most of the Arts and Science men were graduated from those Land Grant institutions which are also state universities; possibly a study covering these institutions only, would show somewhat different results. Perhaps, too, they have entered, in greater numbers than the engineers, fields of business in which the financial rewards, particularly from 1925 to 1928, were especially large.

The U. S. Office of Education report does show that a larger proportion of the arts men than of the engineers had invested capital in business in which they were owners or partners, although in most cases this capital had been earned rather than inherited. It may be that a study of specific types of business from this point of view would be of value but the number of cases available in each would be small.

Finally, there is undoubtedly a difference in the kind—not the level—of native capacities and interests which lead a man to pursue an engineering course on the one hand, or one in arts and science on the other. This difference itself may be reflected in their future earnings. In any event, to stress unduly the differences in curriculum content, without due regard for other variables, is to take a narrow view of the problem. Nevertheless, these figures may indicate that, in the past, engineering education has not given full recognition to the importance of the social sciences and the stimulation of imagination through contact with many fields of knowledge. They do not indicate, for a moment, that a man with aptitude for engineering should turn aside from it or that one may adequately prepare for modern business without some knowledge of the contributions of science to it and some understanding of the scientific method of attack on its problems.

Another fundamental educational question upon which these data bear generally, relates to the economic value of a college education. To ask this question, in no way implies failure to recognize its contribution to citizenship and the enrichment of life. But many parents today are making severe sacrifices to send sons to college in the expectation that the training will contribute to their economic standing afterward. These data provide some evidence that the whole group of college graduates has not maintained its relative economic position during the past 25 years as its numbers have rapidly increased. On the other hand, they have shown a marked advantage for graduates whose age at entrance to college indicates above average intellectual capacity. Such a group of graduates, moreover, seems to have realized on their additional training, when compared with a similarly selected group of non-graduates. The story would be more complete if equally representative samples of all graduates and non-graduates had been available; possibly further analysis of the non-graduate returns on the basis of time spent in college or reasons for leaving would throw additional light on the question. On the whole, however, there seems to be evidence that a college education is of value somewhat in proportion to the intellectual capacity of those who receive it. If this can be proved, it will save many useless sacrifices and even tragedy for those who should not attempt that particular sort of preparation for life.

REPORT OF THE COMMITTEE ON THE ADVISABILITY AND PRACTICABILITY OF CLASSIFYING THE ENGINEERING COLLEGES *

Outline of the Problem.—As the Committee's only instructions consisted of its title, its first task was to construe the problem assigned to it. So far as it knew, no one proposed to rank the engineering colleges in an order of supposed excellence. A mere classification into groups according to form of organization, basis of support, curricula offered, etc., would serve no important end. The distinctions which do or should exist between a "college of engineering," an arts college teaching a group of "engineering sciences" a "technical institute" and a "junior college" were already reasonably clear. However, the Committee noted certain sources of confusion in the status and relations of the engineering colleges which it might be within the province of the Society to clear up. These fall under three heads, which constitute the principal outline of this report:

1. The accrediting of engineering colleges by educational authorities and associations.
2. The recognition of engineering colleges and their graduates by professional organizations.
3. The recognition of degrees from engineering colleges by State licensing boards.

Measures Taken by the Committee.—As it was impracticable to hold meetings of the Committee, its work was subdivided on the following plan. The Chairman drafted a memorandum outlining the questions at issue and submitted it to the other members for criticism. It was then re-drafted as a basis for a series of inquiries, Mr. Rice taking up these questions with the offices of national engineering societies, Mr. Roberts with personnel officers of industries, Mr. Sackett with the State licensing boards and Mr. Wickenden with members of the Council of the S. P. E. E. and with the heads of representative engineering colleges. Of a total of forty-seven Council members and college heads, forty-three replied at length and three briefly. As a whole, the data of the report are believed to represent a broad and well-balanced group of sources.

1. Accrediting of Engineering Colleges

Purposes Served.—The legal right to grant degrees is carefully safeguarded in a few states, of which New York is an outstanding

* Presented at the 39th annual meeting, S. P. E. E., Purdue University, June 17–19, 1931.

example, while in many others the regulations are so lax as to afford virtually no safeguards to educational standards. The laxness of public control has led the more substantial institutions to form voluntary associations, membership in which is a guarantee that certain minimum or qualifying standards have been met. Some of these accrediting associations are regional in character and include both colleges and secondary schools. Others include only higher institutions having a special character or function. The regional associations usually base their qualifying standards on the arts college as a norm, but admit other undergraduate colleges without distinction of type. The functional and professional associations are national in scope and their standards of admission are both more strict and more explicit than those of the regional bodies.

The purposes served by the accrediting associations fall mainly under three heads:

1. To establish qualifying standards for schools and colleges which mark them as worthy of public confidence.
2. To establish a basis for the acceptance of credits for entrance, transfer, or admission to postgraduate standing.
3. To create a channel for mutual counsel and common action within groups of colleges and between these groups and related professional and public bodies.

Accrediting of Engineering Colleges.—The engineering colleges have no distinctive accrediting agency. When accredited by regional and national associations they are rated in accordance with standards devised primarily for arts colleges. An example may be taken from the qualifying standards of the North Central Association of Colleges and Secondary Schools, which covers an area larger than that of any other regional association, and one containing a larger group of engineering colleges.

1. A post-secondary institution legally authorized to give non-professional bachelor's degrees; early years of curricula extend and supplement the work of the secondary school and at least the last two years shaped toward special professional or graduate instruction.
2. Admission by 15 units of secondary work done in an accredited school or evidenced by examinations.
3. A minimum of 120 semester hours of credit required for graduation.
4. A faculty of not less than 8 distinct departments each having at least one full time teacher of professorial rank, the num-

ber of full time teachers to increase proportionately to the student body and the development of varied curricula.

5. Minimum scholastic requirement of all teachers—graduation from an accredited college; two years or more of postgraduate training for teachers of professorial rank and Ph.D. or the equivalent for heads of departments.
6. Teaching schedules exceeding 16 recitation hours per instructor interpreted as endangering educational efficiency.
7. Classes other than lectures of more than 30 students interpreted as endangering educational efficiency.
8. Ability to prepare graduates to enter recognized graduate schools as candidates for higher degrees.
9. Character of curricula, efficiency of instruction, scientific spirit, standards for degrees, etc., factors in determining eligibility.
10. A regular college registration of at least 100 students with an adequate proportion registered in the third and fourth years.
11. Possession of a library of at least 8,000 volumes inclusive of public documents. Possession of a laboratory equipment sufficient to develop fully and illustrate each course announced.
12. A minimum annual income of $30,000 for its educational program and additional income of $3,000 for each 100 students above 200; one-half of this income from other sources than student fees; if not tax-supported, possession of a productive endowment of at least $300,000 and an additional endowment of $50,000 for each 100 students above 200.
13. No secondary school maintained as part of the college organization except for training school purposes.
14. College of liberal arts not accepted unless the professional and technical departments of the institution are also of an accepted grade.
15. Location and construction of the plant such as to insure hygienic conditions for both students and teachers.
16. Inspection by an agent or agents appointed by the Association.

The qualifying standards given above may possibly draw the line between an effective arts college and one of deficient qualities, but are distinctly too low as regards resources, income, personnel and equipment for an effective college of engineering. On the other hand certain standards are of doubtful fitness for engineering schools, such as that requiring shop instructors to be college graduates and insistence on the Ph.D. degree for department heads.

The S. P. E. E. has never acted in the role of an accrediting agency, nor has it defined any standards for its institutional members. When the Society was established technical education was probably more in need of expansion than of protection of its standards. Conditions have since changed significantly. The

country has been well covered by engineering colleges. The professional engineering societies have become actively interested in the educational qualifications of their members. Many states have established laws regulating the practice of engineering by licensure. It is only rarely that new schools of engineering are being established under public support or with adequate endowment. On the other hand a considerable group of proprietary schools have grown up, with slender resources and uncertain standards. As these institutions depend on advertising and solicitation for students and on fees for their support, their ethics are not always above question. The Y. M. C. A. has established a chain of degree-granting schools within its city associations with an undoubtedly sincere desire to render a worthy service, but in nearly all cases with very slender equipment and resources for the program attempted.

Possible Value of an Accrediting Agency for Engineering Colleges.—Would an accrediting standard have value to the engineering colleges as such? Apparently it would offer little direct advantage to the strongly established institutions, but might be much desired by the newer ones. Indirectly it would give the established institutions some control over the growth of the system of which they are a part, provided the standard of recognition is high enough to be a spur to promising new undertakings and to deter those which are ill-advised.

Accrediting may be of value as a guide to the acceptance at par of the credentials of students wishing to enter one of the established colleges by transfer or as candidates for higher degrees. The accredited list of the Association of American Universities is undoubtedly very influential in these respects.

Attitudes of Engineering Educators.—Four specific questions were raised in the memorandum and inquiry sent to a representative group of forty-seven leading members of the S. P. E. E., all members of the Council or heads of institutions. Those questions, together with summaries of the replies received, were as follows:

1. Do the present accrediting standards of the regional associations and of such national bodies as the Association of American Universities and the American Council on Education, none of which relates in any distinctive manner to engineering, meet all the requirements of the engineering colleges?

   Yes—4. No—36.

2. In your judgment is it desirable for the S. P. E. E. to establish and maintain a distinctive standard for accrediting engineering colleges?

Highly desirable	21
Moderately desirable	13
Scarcely worth the trouble	3
Distinctly undesirable	3

3. In case the S. P. E. E. should undertake to frame and administer an accrediting standard what should be the relative order of importance given to the following aims?

	Numbers assigning importance in the order —					
	1	2	3	4	5	6
To check the establishment of schools with inadequate resources and uncertain standards	18	3	4	6	3	1
To upgrade the weaker institutions now existing	7	9	8	0	4	4
To encourage new institutions to accept the status of a technical institute or a junior college	2	7	6	6	5	6
To aid in evaluating the credentials of student transfers and candidates for postgraduate standing	5	4	5	4	4	8
To aid in establishing suitable standards of recognition by professional societies	7	5	5	7	6	1
To aid in establishing suitable standards for licensing engineers	1	9	6	5	3	4

4. In case the S. P. E. E. should undertake to frame a standard for accrediting engineering colleges, what relative weights should be given to each of the following factors?

	Numbers assigning degree of weight —			
	Much Weight	Moderate Weight	Little Weight	No Weight
Requirements for admission—total	27	11	1	0
Specific requirements for admission	16	17	6	0
Requirements for graduation:				
Total weeks of attendance	19	12	5	0
Total hours of instruction	20	14	1	0
Total credits	11	24	1	0
Credits in sciences	25	12	1	0
Credits in humanistics	7	28	3	0
Credits in major technical field	18	18	2	0
Credits in other technical fields	7	28	2	0
Number of teaching staff, relative to enrollment	22	15	2	0
Proportion of teachers of senior ranks	13	20	4	0
Scholastic qualifications of teachers	26	13	0	0
Experience qualifications of teachers	27	11	1	0
Professional affiliations of teachers	15	18	4	0
Income, relative to enrollment	13	24	3	0
Income, proportion not derived from fees	7	19	8	2
Value and character of equipment, relative to enrollment	18	22	0	0
Extent of library	14	21	1	1
Inspection of authorized agents of S. P. E. E.	15	15	7	0

Comments on Questions and Replies.—It is plain that a fairly strong sentiment exists in favor of a distinctive standard for accrediting engineering colleges, and that the S. P. E. E. is looked upon as the proper agency to take this work in hand. These views are not unanimously held, however. In addition to the formal replies tabulated, the heads of four leading institutions expressed strong disapproval by letter and one a qualified disapproval. On the other hand, two equally prominent educators voiced strong approval by letter. The dissenters held to the view that the setting up of an accrediting standard would accomplish no good purpose, but would lead to friction and that such an activity would be inconsistent with the traditions and aims of the Society.

It is also plain that the dominant aim of those who favor an accrediting standard is to check the spread of schools with inadequate resources and uncertain standards and to bring pressure to upgrade those already existing.

Views on the possible criteria of accrediting are strikingly consistent, with the greatest weight on the qualifications of teachers, admission requirements and the credits required in scientific branches.

Rating the Product vs. Rating the School.—There is a background of sentiment, more often expressed in letters than in the formal answers and comments, that a really valid accrediting system should be based on the human product of the colleges rather than on any quantitative rating of their requirements, resources and staffs. Certain of the industrial representatives consulted especially urged this point of view, though many educators seconded it. As an actual means of rating, it was suggested that comprehensive qualifying examinations be given to graduates and the colleges be rated by the results.

Discontent with formal statistical standards of accrediting seems to be on the rise in other circles. This discontent has prompted the North Central Association of Colleges and Secondary Schools to undertake an extensive study of possible qualitative standards. The striking fact that the lowest seniors in certain Pennsylvania colleges outranked the highest seniors in others in recent tests of general educational achievement is at least suggestive of the possibilities of rating colleges by their product. As the industrial representative in the committee expresses his views:

"After some years of association with work which has brought me in contact with many young men from many schools, I am inclined to wonder if it is the school we want to classify as much as the men." . . .

"How about a hurdle or a series of hurdles which any engineering college, no matter what its endowment, size, or character of curriculum, might set up under the auspices of the S. P. E. E. for its graduates to undertake to jump?—A classifying examination, as it were, to be given under uniform conditions at all schools desiring to use it?"

2. Views of Personnel Executives in Industry

Summary of Views on Accrediting.—Your Committee deemed it wise, as a part of its investigation, to submit to personnel representatives in industries, the same memorandum which it used with the secretaries of the national engineering societies, local engineering societies, heads of representative engineering schools, and state licensing boards, in order to learn what bearing, if any, an S. P. E. E. standard of accrediting would have on the relationships between the colleges and the industries.

To this end, personnel directors or executives in direct charge of educational and personnel training programs in thirteen selected companies were asked for opinions. The list was chosen to include public service corporations, as well as manufacturing and selling industries engaged in the chemical, metal, electrical, and automotive businesses. At the time of the preparation of this report, ten of the thirteen companies had responded.

Generally, the expression indicates that from an industrial standpoint it is only moderately desirable for the S. P. E. E. to establish and maintain a distinctive standard for accrediting engineering colleges, and that it is a problem which the Society should approach only with the greatest caution. The feeling is quite distinct that such a plan, if pursued too rigidly, would discredit or eliminate certain schools where excellent work is now done. The industrialists feel, however, that if any movement of this sort is undertaken, it should be coöperative, but under the leadership of the S. P. E. E., with the fullest coöperation with the national and state engineering societies and licensing boards.

There is a distinct feeling, however, that the S. P. E. E. should use its offices no further than is necessary to establish a helpful attitude of coöperation among the interests affected, and that especial care should be taken to avoid even the appearance of undertaking to legislate on this important matter.

Evaluating Efficiency of Instruction.—The industrialists repeatedly express the opinion that the greatest field for improving the product in the engineering colleges lies in the direction of *more careful selection of students for admission* and an *improvement of the quality of the instructional staff,* particularly those junior mem-

bers of the leading staffs with whom students come most largely in class-room contact.

They are especially concerned over the outcome of an effort to evaluate the efficiency of instruction. Several of them express the opinion that while it would be interesting to know much about the physical equipment, type of organization, legal status, courses offered, subject matter, length of course, number of students, number of faculty, etc., yet, that the most important thing is the instructors themselves. Splendid work, it is pointed out, may be done by a splendid corps of instructors on a limited schedule and with meager equipment.

A number of the industrialists feel loath to express their opinions on the matter of accrediting, stating that their opinion is only that of laymen, and that the problem calls for the answer of an educational professional. For the most part, they reflect the feeling that the burden of maintaining standards is upon the shoulders of the student, and that a lasting standard for the school itself cannot be legislated. Clearly, they are not anxious to see any movement whereby attendance at or graduation from any particular school carries with it priority. They would not see the time come when engineering societies, many of whose members have acquired their engineering training from the so-called "school of hard knocks" and without the benefit of a degree, yield precedence to their more fortunate degree-bearing brothers.

One industrial representative sums the matter up this way, and it seems not unlikely from the tone of several of the other responses that a goodly number of the representatives of industry would be inclined to support him in his expression:

"It is my belief that it would be wiser for the Society to attempt to establish an annual comprehensive examination for all engineering students, rather than to take the initiative in directly classifying engineering colleges. An examination of this kind might be conducted somewhat as the Regents' examination in New York State, or the bar examinations for young lawyers. Under such a plan, schools would automatically classify themselves according to the average showing of their graduates. Undoubtedly it would be discovered that even the best engineering schools turn out some poor engineers, and that some of the weaker schools occasionally turn out some outstanding men. If the relative standing of graduates were known, a weak school would be encouraged to strengthen its relative position, and the stronger schools might, if they reduced their efficiency, lose their positions."

3. Recognition of Engineering Colleges and Graduates by Professional Organizations

Present Status of Such Recognition.—Most of the national societies and many of the local societies give credit toward membership requirements for graduation from an engineering school of "recognized" or "acceptable" standing. Some restrict the organization of student branches or chapters to institutions of this rank. Both regulations and practices vary considerably. The A.S.C.E. has an accredited list to which it admits institutions only after detailed investigation. The A.S.M.E. and A.I.E.E. follow a discretionary policy, but in a more tacit fashion. Graduates of non-accredited institutions are not refused credit for their education, but the amount given may be scaled down below the maximum.

Experience in other fields of professional education indicates that no other influence is so effective in eliminating inferior schools and in upgrading those of a marginal character as the giving or the withholding of formal recognition by the major national organizations of the profession. The executives of certain of the national engineering societies have expressed some concern that this problem should not be neglected in engineering circles until it has reached an acute or possibly unmanageable stage. Without speaking officially for their societies, they have intimated that the initiative of the S. P. E. E. in setting up an accrediting standard would be welcomed.

The present situation is apparently this: Certain societies are exercising discrimination in their recognition of engineering colleges and have a definite policy to pursue; certain others would probably take similar measures if the S. P. E. E. fixes an accrediting standard; while one or more others prefer to remain passive. It is an open question whether the S. P. E. E. would prefer to retain the initiative or to have a pass into other hands.

Views of Educators on Formal Recognition.—In view of the rising interest of the professional societies in the educational qualifications of their members, it seemed worth while to ascertain the opinions of representative engineering educators on the S. P. E. E.'s responsibility in the matter. The following question was included in the inquiry, with replies as tabulated below:

Should the S. P. E. E. leave the national and local engineering societies the entire responsibility for standards of recognition of engineering colleges and their graduates, or should the S. P. E. E. endeavor to bring those societies to some common policy and standard?

S. P. E. E. should keep hands off	1
S. P. E. E. should take the initiative	30
S. P. E. E. should coöperate when invited but not assume leadership	10

Views of the National Engineering Societies.—The following statement has been supplied by Mr. George T. Seabury, Secretary of the A.S.C.E. at the instance of Mr. Rice on behalf of the Committee:

"*Classification of Engineering Education Institutions.*—As a fundamental it is to be recognized that although the Founder Societies are some 50 years or more of age, they have until recently held rather rigidly to the attitude that their function was merely to foster and disseminate those technical matters in which their members were primarily interested. Within the past few years, however, there has grown a very definite consciousness that in doing so they have been failing to render service to their members along lines which contribute to their material well-being, not so much as to individuals, as to a group, worthy and in need of more specific recognition of value by the public. I say this has been a growing consciousness. In many cases it has not as yet resulted in specific action or a definite grasp of the problem in so many words, but it has resulted in efforts along one or another line and in several instances with a satisfactory degree of success.

"There is need for the pointing out of specific aims and unquestionably the classifying of engineering educational institutions is one of these. The American Society of Civil Engineers for 40 years has held rigidly to the principle that it will give special credits to those applying for membership and graduating from accredited schools of engineering. It recognizes only accredited schools in the establishment of its Student Chapters and has made this operative not only positively but negatively as illustrated by the action of its Board of Direction last June, when it withdrew recognition of two educational institutions in Mississippi on the belief that under the conditions which at that time existed, namely, a wholesale dismissal of the existing Faculty and the immediate installation of a new Faculty, a situation prevailed which could not be conducive to the carrying on of a satisfactory educational program.

"With such an instance of practicability in hand, it is my belief that when the matter shall have been made thoroughly plain to the governing bodies of all the Founder Societies, a similar attitude can, in a not too great a length of time, be adopted by them all. In admitting to membership, not all the Founder Societies have held the point of view of the American Society of Civil Engineers, namely, that it is to be exclusive. Some of the very worthy officers

and able leaders of the other Societies have maintained that the function of a Society is to be inclusive and while not an eleemosynary institution, a Society is none the less to consider itself a source of education available to those who are interested to take advantage of the opportunities provided.

"*Registration of Engineers.*—The undertaking of such an endeavor (classification of colleges) would be the undertaking of what might be called the establishment of the minimum definition of engineering, or of an engineer, and such an idea is closely allied with the legal idea of registration of engineers. Registration of engineers is a legal matter but the force of opinion as would be expressed by the Engineering Societies will be of such character when attained that without doubt in a very great majority of cases the attitude of those Societies will be operative under the State Laws. To undertake the classification of engineering schools into the two grades of the acceptable and unacceptable and to correlate with it the setting up of requirements which shall be prerequisite to registration of engineers are, I believe, two objectives, within easy access, as methods by which the governing bodies of the several societies will shortly be ready to give expression of this consciousness of the broadening of the functions of the societies."

"*Professional Degrees.*—These are two fairly clear-cut objectives and with them may be placed a third which is, perhaps, equally clear cut and which seems to be an objective greatly to be desired and equally practicable because so closely allied. Reference is made to the granting of professional degrees. The Colleges heretofore have made them of too little value on the one hand or have made them too much of a burden on the other. The growing practice of discontinuing the C.E., M.E. and E.E. degrees at the end of four years' work and the granting in their stead of the Bachelor degree, has resulted in the comparative disuse of the professional degrees. In contrast the placing of the C.E., E.E. degrees, etc., more on a parity with the Master and the Doctor degrees, is one which has received general approbation from the Profession. To grant the professional degree at the end of a four-year term has been considered as inappropriate. On the other hand the requirements by many of the Institutions have led to a general neglect of the opportunity to secure the professional degree. As a result it is seldom to-day that one sees the use of the letters indicating the possession of a professional degree.

"To develop a method whereby the attainment of a professional degree may be achieved in terms of professional work with the minimum possible supplementary academic requirements would, therefore, constitute another objective which this conscious-

ness of the Profession for the improvement of its general status would recognize as valuable and as one to be striven for.

"*Summary.*—To sum up, therefore, it is my belief, a belief supported by several vigorous and well-sustained actions of the Board of Direction of the American Society of Civil Engineers, first, that the engineer of to-day is desirous of his professional society taking leadership for him and the profession in matters directed toward other than his technical welfare; second, that with an understanding of the pioneering work already undertaken and its salutary effects already observed, the classification of engineering colleges is a program of which there can be and should be shortly a unified acceptance by the Engineering Societies; third, that the establishment of minimum requirements for engineers who are to be registered is so closely akin to the classification of engineering institutions that it too will be accepted by the Engineering Societies as an objective to be attained simultaneously or perhaps as a corollary to the first-named objective; and fourth, that there should follow strong approval from the Engineering Profession for a unified program of the granting of professional degrees on a plane practically identical with that which will be established by the two previously named objectives. It is my suggestion that the working out of such a program as outlined be done jointly by representatives of the Engineering Societies and the Society for the Promotion of Engineering Education. It seems as if no part of the program could suceed without such a coöperative attitude."

Comment.—A corporate spirit is gradually developing among American engineers, but resists being hurried. As this spirit matures, clearer definitions of professional standards and ethics will doubtless emerge, but any action which seems to create priority for graduates over non-graduates, or priority for graduates of certain schools over others, would be viewed very critically at the present stage. Tradition among engineers in the Latin countries leans strongly to the caste ideal; the schools are strictly regulated by the central governments, admissions are restricted and, in Italy at least, strict licensing regulations are enforced. In Central Europe, the caste system is not legalized but is effectually maintained by the prestige of State-awarded diplomas. In the English-speaking world the engineering profession still embodies the survival-of-the-fittest ideals of the industrial revolution out of which it grew, and in America this spirit has been intensified by the extreme individualism of the self-trained engineers of the pioneer period .

Whatever measures the engineering colleges may initiate which might tend to draw more sharply the lines of professional recognition need to be timed with careful regard to the sentiment of pro-

fession if they are to gain the support of its organized bodies. Without this support such measures may amount to little more than futile gestures. Many leaders in engineering education appear to sense some such danger. This is implied in their desire not to have the S. P. E. E. take an extreme stand, either one of total passivity or one of wholly independent action, but to move forward in defining qualifying standards only as fast and as far as it can enlist the sympathetic coöperation of the national engineering societies.

4. Recognition of Engineering Degrees by State Licensing Boards

Is the S. P. E. E. Concerned?—No uniformity exists in the regulations of the licensing boards which several of the states have established. The University of the State of New York registers 101 of the engineering colleges in the United States in full and grants partial recognition to six others. It seems probable that any accrediting standard which the S. P. E. E. might adopt would have considerable weight with these boards, especially if it had the sanction of the principal national engineering societies. Again, the question may be raised whether or not the Society would be content to have the initiative pass into other hands.

The Committee has had considerable correspondence with State licensing boards in an endeavor to learn their views of the possible value of an accrediting standard should the S. P. E. E. decide to establish one. Through this channel it was learned than an accredited list has been prepared by the National Council of State Boards of Engineering Examiners of which Dean P. H. Daggett of Rutgers University is Secretary. The Committee requested information on the basis of selection, which has not yet been supplied. The replies of the officials of the State boards on the question of the advisability of the S. P. E. E. setting up an accrediting standard, so far as its service to them was concerned, may be summarized as follows:

Board	Answers	Comments
Colorado State Board of Examiners for Engineers and Land Surveyors	Yes	
Florida State Board of Engineering Examiners	Yes	
Department of Law Enforcement, State of Idaho	Yes	Important item, a high type of teaching personnel
Iowa State Board of Engineering Examiners		Reference to work being done by Dean Daggett
Louisiana State Board of Engineering Examiners	Yes	Important items, entrance requirements, curricula, personnel, teaching loads, etc.

Board	Answers	Comments
Michigan State Board of Examiners for Registration of Architects, Engineers and Surveyors	Yes	Important items, nature and extent of curriculum, size of classes, total number of teachers and students
Minnesota State Board of Registration		Reference to work being done by Dean Daggett
The University of Mississippi	No	
State Board of Professional Engineers and Land Surveyors, New Jersey	Yes	Important items, creditable work with proper staffs and necessary equipment
University of the State of New York	Yes	Should coöperate with national and state engineering societies in an endeavor to establish proper standards
State Board of Registration for Engineers, West Virginia	Yes	Important item, qualifications of teaching staff. Reference to Dean Daggett's work
Oregon State Board of Engineering Examiners	Yes	
State Registration Board for Professional Engineers, Pennsylvania		To be presented to Board. President's view unfavorable
State Board of Architectural and Engineering Examiners, Tennessee		Of some, but doubtful value
State Board for the Examination and Certification of Professional Engineers, Architects and Land Surveyors, Virginia		Reference to Dean Daggett's work
State Board of Examining Engineers, Wyoming		Probably valuable to various Boards, but of little value locally
Board of Registration for Professional Engineers, Arkansas		Reference to National Council of State Boards
Board of Registration for Civil Engineers, California		No use of a second list unless S. P. E. E. and National Council work through a joint committee

Reactions of Educators.—The question of the responsibility of the S. P. E. E. for initiative was put to the educators consulted in the following terms, with replies as tabulated:

Should the S. P. E. E. concern itself with the registration standards of the several state licensing boards for engineers in so far as the recognition of college training is concerned?

S. P. E. E. should leave the entire matter to the licensing boards 3
S. P. E. E. should coöperate with national and state engineering societies in an endeavor to establish proper standards 31
S. P. E. E. should seek to provide a standard for recognition of college degrees 8

5. Conclusions and Recommendations

The data presented above constitute, in our belief, a fair cross-section of well informed judgment on the issues considered. A unanimous view was not to be expected, but the margin of opinion in favor of the Society's accepting responsibility for some form of accrediting of engineering colleges or evaluation of their work is impressive. The experience of other organizations and the opinions of our own constituency indicate quite clearly that it is practicable to set up and apply a qualifying standard of a quantitative and objective character.

The question of the relative value of such an accrediting standard and of some test which may be applied directly to the product of the college is not so easily disposed of. In view of our long-standing tradition of freedom from imposed standardization and of the present movement away from statistical standards in the older accrediting agencies, an attitude of hesitation or of dissent among engineering educators is easily understood and deserves to be respected.

The proper course of action for the Society would be clearer if the national engineering societies were now ready to coöperate actively in defining the objectives and in evaluating the standards of engineering education. Only one of the four founder societies is ready for active collaboration, one is quite definitely opposed in policy and two appear to be passive in their official attitudes, although their secretaries are individually sympathetic to some plan of joint action with the colleges. Informal conferences held with the national secretaries as a group, however, indicate that any decisive action which the S. P. E. E. may take in defining standards will have a strong and, on the whole, a favorable influence on the national societies.

In the inquiries to date no direct reference has been made to the expense of administering an accrediting system. Fairly strong support may be noted for the inspection of institutions seeking to be accredited by the Society, though the question of re-inspection at intervals has not been raised. A relatively casual inspection could be made at an average cost which might fall between $50 and $100, while a thorough-going inspection might be expected to cost upwards of $500. If the Society's treasury were to bear the cost of inspections it might be necessary to increase greatly the dues of its institutional members; if the costs should be charged to the institutions applying to be accredited, the expense might discourage the very ends which the Society is seeking to promote unless the result seriously affected the recognition of the institution by professional societies and licensing boards.

The Committee feels that its inquiry has been carried far enough to disclose the consensus of opinion among the several groups which might be affected by an accrediting system; that other alternatives, such as comprehensive tests which might be given to graduates of all engineering colleges, ought to be carefully studied before a course of action is decided upon; that the present time is inopportune for action independent of the national engineering societies; and that closer contact should be established with the National Council of the state boards of engineering examiners and the possibilities of joint action with that body considered. It therefore recommends:

1. That no action be taken by the Society for at least one year;
2. That the work of the Committee be continued and that especial attention be given to possible joint action with the national engineering societies and the National Council of State Boards of Engineering Examiners;
3. That a coöperating committee be appointed to investigate the alternative of comprehensive examinations for graduates.

Committee:

CALVIN W. RICE,
EMERSON B. ROBERTS,
R. L. SACKETT,
W. E. WICKENDEN, *Chairman.*

REPORT OF THE COMMITTEE ON RELATIONS OF JUNIOR COLLEGES AND ENGINEERING SCHOOLS *

Five years ago there were 153 junior colleges in the United States; this year's report shows 436 with 74,000 students enrolled, although this is now ancient history. Approximately one-fourth of these junior colleges offer courses in engineering, according to the secretary of the Junior College Association. That is the reason Secretary Bishop says engineering colleges must become junior college conscious.

"The junior college, as at present constituted," according to the definition of the American Association of Junior Colleges, "comprises several different forms of organization; first, a two-year institution embracing two years of collegiate work in advance of the completion of what is ordinarily termed the twelfth grade of an accredited secondary school; secondly, the institution embracing two years of standard collegiate work administered as a single unit. . . ."

Junior colleges may be classified as public and private. Public junior colleges constitute only 40 per cent of the total, although they enrol 62 per cent of the students. This is accounted for by a small average enrolment in the private institutions.

Eells has facetiously stated, with reference to junior college development, that "some institutions have cut off their heads—the four year college; some have stretched their legs—the four-year secondary school; some have grown additional legs, a centipedal institution such as the University of Pittsburgh." The public variety is almost invariably a high school organization that has been stretched, *i.e.*, has added two additional grades to the traditional twelve. The decapitated group are four-year colleges which have cut off the junior and senior years, thus reducing their offerings to two years.

The third type, characterized as centipedal having grown additional appendages, is an organization where a well-organized university or college establishes or takes over the administration of one or more junior colleges as branches. The University of Pittsburgh is an example of this type. It has established three junior colleges during the past four years in three cities in Pennsylvania which are from 60 to 90 miles distant from the main campus. These three junior colleges are under the direction of University officers and are

* Presented at the 39th annual meeting, S. P. E. E., Purdue University, June 17–19, 1931.

integral parts of the University. Columbia University and the University of Chicago each has a junior college under its direction, wholly or in part. Aside from these universities in the North, most of the samples of this arrangement are found with the denominational colleges of the South. Emory University, Millsaps College, and Austin College, and others have junior colleges under their supervision and control.

A fourth type might be added for a third of the private junior colleges were chartered as two-year institutions and have continued as such.

Four states report a junior college enrolment of more than 5,000 each—California, Texas, Illinois, and Missouri. These four states, in the order named, have a third of the junior colleges (135) and contribute almost half of the total junior college enrolment (39,042 out of 74,088). This is due mainly to the unusually large public junior college enrolment in these states. Only five states in the Union at the present time report no junior colleges.

The junior colleges usually offer the typical curricula found in the first two years of the liberal arts college, including pre-professional courses. In addition, a few have introduced courses of a semi-professional nature terminating in two years in such fields as industry, engineering, music and home economics.

Inasmuch as most junior college pre-engineering curricula are designed to parallel the curricula in the first two years of the leading college or university in the community, the junior college work is usually supervised or sanctioned by the senior institution, even though there is no administrative connection.

Junior colleges are accredited in most areas by the regional accrediting association, the state department of education, the state college association, the state university, or by the American Association of Junior Colleges. The American Association of Junior Colleges does not act as an accrediting agent except where no authorized agency takes account of the junior colleges. A directory showing accredited colleges and by whom accredited is published in the Junior College Journal, for January, 1931.

The junior college has undoubtedly established itself as a unit of our educational system. A thriving junior college association exists, having held its eleventh convention. A journal has been launched during the past year, published at Stanford University under capable leadership. The issues thus far rank high among educational periodicals.

Elaborate studies by Stanford University, Baylor University, Pomona College, Southwestern University, and the University of Pittsburgh indicate that junior college students who go on to higher institutions measure up to standards of the senior college

as well as students who take their freshman and sophomore work at the senior institution. Dean Hoover at Stanford states that the students who come to them from the junior colleges do as well or a little better than those who take all their work at Stanford.

Our committee appointed to make a report on the relationship of the junior college to engineering schools sent a query, almost at random, to a small number of junior colleges and engineering schools to determine what the issues were that needed attention. Eight engineering colleges and twelve junior colleges, geographically well distributed, gave us the benefit of their experience. The value of this report, insofar as it has any value, will be in the information it brings us, first, of the status and scope of the junior colleges, and, second, the points in the relationship between the two educational units where there seems to be discontent. We asked for outstanding problems which arise with reference to curricula in engineering with respect (*a*) to terminal courses in junior college, and (*b*) to relationships between junior colleges and the engineering schools in colleges and universities.

Terminal Courses

The recent investigation on technical institutes by Dr. Wickenden's committee has shown the need for terminal courses so clearly that we were interested to know the attitude junior colleges were taking toward the problem and what was being done about it in terms of definite curricula.

The chief problem with terminal or semi-professional courses in junior colleges seems to be that of getting students to enrol in them, especially students of the type having the maturity and intelligence to profit by the training.

Professor Thorpe says, "The Sacramento Junior College has offered a terminal course in engineering drafting since 1928. It has attracted very few students and only three have completed the course and entered the semi-professional engineering field. There seems to be no call among entering freshman students for terminal courses."

President Cortright of the Junior College of Connecticut states that his problem ". . . has centered around the difficulty of getting people to know that these courses are of college grade. While the people taking these courses are not necessarily seeking college credit, and while high school graduation may not be required for entrance into the courses, it is necessary that the individual entering them have sufficient maturity and experience to profit by the instruction given. A larger percentage of our terminal courses lie in the field of commerce and business, rather than in the field of engineering education."

Accrediting associations seem to stand in the way of this important development according to Dean Spelman of the Morton Junior College. "We have been thinking about the engineering terminal courses with the idea of following the work given along similar lines in Pasadena Junior College and in the North Dakota State School of Science. However, thus far, we have hesitated actually to put the courses into operation because of the fact that they would not be accepted by the members of the North Central Association."

Dean Hancock states that lack of room prevents introduction of terminal courses at the Crane Junior College.

The difficulty of obtaining qualified instructors and the expense involved in providing equipment is emphasized by Director Shockley in charge of the junior colleges of the University of Pittsburgh as major factors in the slow growth of terminal course work, especially in the smaller centers.

More serious than technical difficulties seem to be certain psychological ones. In many places where terminal courses and preprofessional courses are offered on the same campus a social barrier has developed between the two groups of students and in many cases, if not encouraged, it has not been discouraged by the faculty. Because of the lack of social prestige many students have chosen regular curricula only to be among the more than 50 per cent who are eliminated.

In spite of these difficulties a number of junior colleges have launched successful courses. Joliet Township Junior College offers a terminal course in junior electrical engineering which has much to recommend it. North Dakota State School of Science has been referred to by Dean Spelman. Perhaps the most ambitious program that has come to our attention is that at Pasadena. Principal Harbeson states that "committees are at work on the development of a four-year curriculum extending from the eleventh through the fourteenth years in engineering which we hope will prepare for the semi-professions of a technical character." Starting this fall, technical courses in five fields are being offered: Civil technology, mechanical technology, electrical technology, aviation, and building practice and design. The Johnstown Junior College of the University of Pittsburgh has rearranged the sequence of certain courses in order to provide two-year curricula in engineering and business, but it is too soon to appraise results. These curricula were introduced as the result of the findings of a survey of industries in Johnstown.

These efforts are to be highly commended. The junior colleges and technical institutes which solve the problem of the terminal course will make a real contribution to engineering education.

Problems of Articulation from the Standpoint of the Junior Colleges

The institutions in which coöperative planning of curricula exist report the least difficulty in articulation. In states where one senior engineering school is the outstanding goal toward which students aim, as in Minnesota, we find the best situation. Hibbing and Duluth Junior Colleges report no major problems in adjustment with the state university. This, they report, is because their curricula are planned jointly with the state university. It is when students decide to go elsewhere that the trouble begins. In states where two or more engineering colleges exist with different curricula both in content and sequence it is impossible, unless the junior college is exceptionally large, as at Kansas City, Missouri, to provide preparatory work which insures complete articulation and at the same time keep classes within reasonable cost limits. The necessity for providing so many differentiated curricula, especially in the sophomore year of the engineering course, has forced a number of junior colleges to offer only one year of pre-engineering. This is true of the Wichita Falls and St. Joseph junior colleges. In others, the junior college attempts to patch out a curriculum for the student if he announces his final senior college destination soon enough; if not, some loss in time and money is inevitable.

Dean Chadwick of Duluth Junior College raises the question: "Why can't the sophomore year of engineering be the same for all engineers, the same as for the freshman engineer? Doesn't the engineer need at least two years of common education devoted in part to engineering and scientific principles and in part to general and liberal courses similar to pre-law, pre-medicine, and pre-dentistry?"

Dean Haines of St. Joseph Junior College asks why the course in general economics, now usually given in the senior year, could not be given as well in the sophomore year. It could be more profitably given as a junior college subject than most professional subjects.

Others add to the chorus:

Dean Spelman of the Morton Junior College points out difficulties in articulation because courses in drawing and shop required at the University of Illinois and Armour Institute are not given in his college. "Purdue University," he says, "for some reason not clear to me, requires our graduates to repeat descriptive geometry even though we require eight hours of work with four hours of credit, while they require six hours of work with two hours' credit."

Dean Hancock (at Crane) says "our only problems in correlating with senior colleges are those caused by changes in courses or requirements in some schools but not in others. Especially is this true in such subjects as chemistry, physics, and applied mathematics. At Armour Institute and the University of Illinois, for instance, changes have recently been introduced working in opposite directions. Frequently, a repetition of work is required due to slight divergences or to special emphasis placed upon portions of the work which, they feel, have not been stressed here to the same extent."

Superintendent Haggard of Joliet Junior College has accepted the inevitable lack of uniformity in engineering courses and attempts to fit each student's curriculum to the senior institution to which he plans to go. His problem is in getting the student to announce his plans early enough.

Dr. Crawford, head of the Johnstown Junior College, University of Pittsburgh, states that "almost every engineering school has its own outline of courses, so that any transfer students may expect either to lose some credits or else face the necessity of making up some." The Johnstown Junior College, however, articulates closely with the University of Pittsburgh so that no time nor credit is lost when students transfer to the campus.

President Cortright at the Junior College of Connecticut meets the same problem as other junior college officers arising in the lack of uniformity in curricula of colleges of engineering. Although his curriculum is designed along the lines suggested by the Society for the Promotion of Engineering Education, he has difficulty in meeting such varied requirements as exist. Such variations as two full years of descriptive geometry he believes needs explaining. As is the case with other junior colleges, he provides the curriculum called for by the senior institution. This is possible through a combination of day and evening classes.

Problems of Articulation from the Standpoint of the Engineering Colleges

Turning now to the engineering colleges we find them almost invariably reporting cordial relations with the junior colleges which fit into their curricula. There is a definite feeling in certain quarters, however, that no engineering training should be given in junior colleges and in other quarters that no professional work should be offered—teaching of general fundamental subjects being the sole function of the junior college.

Dean Hoover of Stanford says "There is one danger that must be avoided by the junior college, and that lies in the ambition of

some to try to give professional courses. So far in California we seem to have avoided the danger. As long as the junior college devotes itself to thorough drill in mathematics, physics, chemistry, English, language, and history it will be doing a good work for us. These subjects are enough to fill the two years."

Dean Derleth of California (a member of this committee) would go even further. "When a student knows definitely that he wishes to study engineering and when he can show that he has the scholastic ability to stand high, then by all means he should be urged to go direct to a university and begin his work in the freshman year there."

In Missouri relatively few junior colleges offer professional engineering courses, restricting themselves to English, mathematics, chemistry and physics. Dean McCaustland states that this work is fairly well done but not sufficiently extended to enable a student to enter upon the third year at their engineering college. The Kansas City Junior College, he states, sends students with practically no problems of adjustment; others generally require some adjustments in the third and fourth years.

Dean Shaad states that some difficulties in schedule adjustment with civil and chemical engineers arise at the University of Kansas because geology and certain chemical courses are lacking in junior college preparation—a summer session or a semester additional being necessary in some instances to complete requirements. In architecture, five years is usually necessary for junior college students to complete their work.

If professional courses are not given in junior college, along with the sciences and other cultural subjects, we lose much valuable training which goes to develop the engineering mind. Dean Sadler of the University of Michigan, (in an article entitled "The Junior-College Curriculum in Engineering Schools,") argues for the ribbon type of curriculum, *i.e.*, cultural and professional courses given contemporaneously from the freshman year on. He suggests further that comprehensive examinations be given at the end of the first two years both for the benefit of the student and the university in which the engineering work is completed.

Not all the problems are curricular, however, elimination of unfit students is not always completed by the junior college. Dean Ketchum of the University of Illinois reports pleasant relations with a number of junior colleges, especially with those which plan their curricula definitely to fit the Illinois curriculum. "We do," he says, "however, have men coming from a few junior colleges who turn out very unsatisfactorily. . . . It is our experience that there is as great a difference between junior colleges as there is

between other colleges which send men to the University of Illinois."

The eastern colleges have had little experience with junior college students, although they are in sympathy with the movement. Dr. Tryon, Director of Admissions at the Massachusetts Institute of Technology, says, "A junior college graduate would usually enter our freshman class with a little credit toward his first year's work and possibly his second year English, but there might be some exceptional cases where a student would get more credit than this." High standing students from junior colleges are admitted without entrance examinations.

While Yale has not been called upon to consider the question, Dean Warren feels certain that their "attitude will be to accept only such candidates as have made exceptionally good scholastic records in the junior college, and, furthermore, to test their accomplishments and aptitudes for work in mathematics, physics, and mechanics by requiring them to take comprehensive examinations in these subjects in the fall before admission. In regard to drawing it would seem to me that we could judge their proficiency in this field by having them submit a statement of their previous course and the plates which they made in the course."

One wonders whether or not there might be the same problems of personal adjustment at this period as at the freshman period. Dean Holbrook at Pittsburgh says in this regard, "Junior college students make good. My ranking junior this year is a junior college student from Johnstown. At the recent commencement one junior college student graduated with high honor and two graduated with honor. There is a curious slump, however, in work during the first four to eight weeks that the junior college students are on the campus. But the rebound is sure. This is true because faculty representatives from the campus schools are placed in our junior colleges and work is supervised carefully from the home base, assuring students of proper training."

Summary

The problems raised by this inquiry may now be summarized in question form as a challenge to the parties concerned:

1. How does the fact that junior colleges have increased 300 per cent during the past five years concern us as a Society?

2. What valid reasons are there for and against the introduction of terminal courses into the larger junior colleges? What should accrediting associations be doing about this problem?

3. Is there any possibility of agreeing upon a common curriculum for the first two years of the engineering course?

4. Should the junior college attempt to offer professional engineering courses? If not, how can the ribbon type of course be maintained. Must the junior colleges give up engineering courses entirely?

5. Does the expense involved justify junior colleges offering pre-engineering curricula?

6. Is the elimination of unfit students effectively accomplished in the junior college?

7. Can students' success in the senior college be predicted better by a comprehensive examination at the end of the junior college than by the course-credit plan? Should the test be given for comparison to all engineering students whether in junior college or in the engineering college?

8. What is the best plan for accrediting junior college graduates? By institutions, through accrediting associations, or by individual students?

9. Are problems of personal adjustment more serious at the end of the junior college years than in the freshman year?

10. Is vocational guidance as effective in the junior college as in the environment of the engineering college?

11. Are junior colleges admitting to their pre-engineering curricula sufficiently well selected students to insure reasonable success in the senior institutions?

Respectfully submitted,

CHARLES H. DERLETH,
J. H. SANTO,
CHARLES F. SCOTT,
WALTER B. JONES, *Chairman.*

DISCUSSION

R. A. White, Grand Rapids Junior College: Perhaps it would not be out of order if I start my remarks by making them rather personal, telling of our experiences in Grand Rapids in organizing the junior college.

I was engaged ten years ago to organize the engineering department at the junior college at Grand Rapids. Because I had come from engineering practice and had very little experience in teaching in a university or college, it was quite natural that I should follow the line of least work and find out what was being done in the Engineering College at the University of Michigan. This I did, and we organized the courses at the Junior College to parallel very closely the courses at the University of Michigan. This was logical, also, because we anticipated that most of our students would go on with their work at the University of Michigan,

and that is what has happened. Dean Lovell, if he were present, could tell more than I can, perhaps, how the Junior College students have gotton on at the University.

Perhaps I might try to answer some of these questions. "How does the fact that junior colleges have increased 300 per cent during the past five years concern us as a Society?"

Those of you who heard the paper read by the Professor from Texas yesterday afternoon realize that in certain states at least it is a very serious problem, a problem in which the Society ought to be concerned.

As to terminal courses, we make mention in our catalog that there is a demand in industry for students who have had what corresponds to the work that we give in the engineering college, that is, students who have had work in physics, chemistry, mathematics, and so on. In spite of that, we have practically no students who treat our course as a terminal course. Practically all of them go on to the University. We have a feeling, as was expressed by Professor Cook, that there is not at present very much demand for terminal courses.

The third question is: "Is there any possibility of agreeing upon a common curriculum for the first two years of the engineering course?"

That question has been answered also because most of our students complete their work at the University of Michigan. As I said before, it is logical we should make our work parallel with the University of Michigan. We have two other engineering colleges in Michigan, one the Michigan State College and the other the Michigan College of Mines. We have a certain amount of cooperation also with those two colleges. The Michigan State College takes our students, gives them credit for all the work they have had and gives them the status of juniors. There is required a slight adjustment of courses, but they finish in the two years just the same.

We have had but two students who continued their work with the Michigan College of Mines. In both cases they seemed to have gotten along very satisfactorily.

The fourth question is: "Should the junior college attempt to offer professional engineering courses?"

We are not at all ambitious and we say quite emphatically, no. As our experience has gone, it seems to us that all we can expect to do in the junior college is to give the first two years of work the same as at the University of Michigan.

"Does the expense involved justify junior colleges offering pre-engineering curricula"

As we give the courses now, the expense is very little more than that involved in any of the academic courses. We have an engineering laboratory for the purpose of going along with a course in elementary ferrous metallurgy. That probably has been our largest item of expense, and that has not been very large. We have surveying work now. The expense there was only about $1,000 in getting equipment, so the expense as far as we go, is not large.

The sixth question is: "Is the elimination of unfit students effectively accomplished in the junior college?"

I would like to have Professor Lovell here to answer that, but since he is not here I will tell you that of all the students we have sent from the Grand Rapids Junior College in the last ten years only one has failed to come up to the graduation requirements at the University, and that the average grade which our students have made is about a B.

I will skip the seventh question. The eighth is: "What is the best plan for accrediting junior college graduates? By institutions, through accrediting associations, or by individual students?"

I believe at the University of Michigan it is almost entirely by institutions and not by any other means.

"Are problems of personal adjustment more serious at the end of the junior college years than in the freshman year?"

As my observation has gone, I think not. There is a feeling sometimes that our students are out of contact with extra curricular activities, but this brings about what apparently explains a curious result and that is the quality of work done by our students during their first year at the University. It is better than during the second year and better than the average of the University as a whole, indicating that they have taken their work seriously and have not become involved in outside activities that have in any way interfered with their work.

The tenth: "Is vocational guidance as effective in the junior college as in the environment of the engineering college?"

I think probably not. We have attempted at times to give what would correspond to orientation courses, but we have never gone very far with that. Of course, all of our students have been in more or less of an industrial or engineering environment, where there is perhaps not quite as much need of that sort of thing as at the University where many of the students come from small high schools, small towns, and country communities.

RESOLUTION ADOPTED BY THE MATHEMATICAL ASSOCIATION OF AMERICA

We, the Trustees of the Mathematical Association, wish to express our appreciation of the action of the officers of the S. P. E. E. in organizing and administering a summer school for teachers of mathematics to engineering students. We recognize the very efficient work of Professor H. P. Hammond, director of the summer sessions, and of Dean O. M. Leland, chairman of the session at Minneapolis. The work accomplished is directly in the field in which the Association is interested, but on account of the lack of funds the Association itself could not have carried out the project. We recognize, too, the part of the University of Minnesota in the contribution of its equipment and its moral and financial support.

To the President and the Council,
Society for the Promotion of Engineering Education,
c/o Professor F. L. Bishop, Secretary.

Gentlemen:

Your Committee on Mathematics, at its meeting held in connection with the Summer School for Teachers of Mathematics to Engineering Students, held at Minneapolis on August 24–September 5, 1931, passed the following resolutions for transmission to your body:

Voted, that the Committee feels that the Summer School for Teachers of Mathematics has been highly successful, and that the preparation for it and the conduct of the meetings deserve our unqualified praise; and

That the Committee, through its Chairman, express to the Council of the Society its appreciation of the excellent work done both before and at the meetings by the Director, Professor H. P. Hammond; and

That the Committee, through its Chairman, express to the Council of the Society also its appreciation of the action of the University of Minnesota in granting a subvention for the conduct of the School, and for the many thoughtful provisions made for the comfort and pleasure of those in attendance, in all of which Dean O. M. Leland, and Professor Carl A. Herrick, respectively Director and Secretary of the Session, and others, have played a prominent part; and

That copies of these resolutions be transmitted to the Secretary of the Society for transmission to the Council, and to Professor Hammond, and to the authorities of the University of Minnesota.

Respectfully submitted,

E. R. Hedrick,
Chairman, Committee on Mathematics.

THE NEED FOR SPEECH TRAINING FOR ENGINEERS *

By J. W. PARKER,

Member, The American Society of Mechanical Engineers

In turning to the faculties of the engineering colleges for help in the effort to make a public speaker of the engineer, The American Society of Mechanical Engineers is discovering with not a little surprise how much the English departments in these colleges are already doing. The Society's own attempts have accomplished something but have been on the whole discouraging, probably because it has all been an eleventh-hour kind of training, given to the authors an hour or two before their papers were to be presented. The committee responsible for the conduct of that Society's principal meetings has thought and talked a great deal about the matter for years. They have engaged public speaking coaches for the annual meetings in New York, who held morning classes and drilled the speakers for the technical sessions which followed. They were trying to make up for deficiencies in early training. Some of the younger members have formed classes to much better purpose. The thing should be kept up and no doubt will be, but this committee is beginning to see how much more might be accomplished by good team work with the colleges.

The offer of coöperation with the English teaching group of the Society for Promotion of Engineering Education met with a very prompt invitation to attend the English conference at the annual meeting at Purdue last June. It is not unreasonable to believe that that invitation, which was accepted, will in course of time lead to improvement both in recognition of the importance of the work being done and in the support and encouragement given by The American Society of Mechanical Engineers.

It is not news that educators have been aware for many years of the importance of teaching English and public speaking. The tale has been preached in high schools and colleges, and a great deal of earnest work has been done. Yet the plain fact is that the men are coming to us from the engineering colleges still with insufficient training for the adequate expression of the thought and observation that constitute the substance of their day's work.

* This discussion was Mr. Parker's interesting and stimulating contribution to the Conference on English, Annual Meeting, Purdue University, June, 1931.—S. A. Harbarger, *Chairman, Committee No. 12—English.*

If there is no natural law that decrees that an engineer shall be incapable of expressing his thoughts in public, to his fellow professionals or to associates in the larger community in which he is living, one is at least tempted to think there is. Long years experience with engineering reports, made in writing with graphs —oh many graphs—and tables and drawings, or made verbally before even small groups, calls to mind many a good story spoiled in the telling and much good engineering data mishandled through poor presentation. And these were highly trained, competent engineers suffering from a lack of training in systematic thinking and logical presentation of the work they had done. Every engineering executive, every engineer of matured experience, knows these things and knows they should not be.

If the student in college appears indifferent, it is not the result of a mistaken contempt for such accomplishments. It is rather that he gives his chief attention to what appear to him to be the most practical courses offered him, because it is on these practicabilities that he finds chief emphasis placed. If he believes that it is in the applied science courses that his principal interest lies, "there will his heart be also." If the trouble arises from his too tardy realization of the values of things, was it not the part of a sound education to forewarn him, to compensate for his own lack of experience?

The difficulty runs deeper than a mere lack of facility with spoken words. It is rather an indication of a more fundamental fault in the very backbone of his education. Nor does it appear that just training in English composition and in debating supplies the entire remedy. The fundamental teaching policy of the college is involved.

One abominable custom has arisen of late in some colleges, of conducting examinations by means of long questionnaires which the student must fill in, a check mark here, a yes or no there—if this accurately reflects the modern methods of giving instruction in engineering fundamentals, what can be expected of the product, but that it will be a narrowly trained technician capable only of answering questions put to him by some smarter interlocutor? It is not just for ornamentation that wise corporations brigade competent salesmen with their technical experts when they go out to interview important clients.

Somehow the men in college must be made to understand. The matter must not be ignored in both precept and example by the teachers of engineering in the belief that a devoted English department can shoulder all the responsibility and do all the convincing necessary. It is the manner in which the engineering fundamentals are taught that is important and the insistence that

information imparted to a student is of little effect if he cannot restate what he has received in convincing fashion.

Often one has seen the characteristics of the head of a great industrial corporation reflected with surprising fidelity in the every-day dealings of the members of his organization, even the least of them, as they go about their day's work. In some such manner can the interest of the head of a faculty in this matter of English training be reflected in the quality of the instruction given throughout the college.

For their part, members of The American Society of Mechanical Engineers can assist vitally. The teachers of English need their hands held up. The time will come, it may well be hoped, when they will constitute a staff department, not only giving courses in English and public speaking but substantially empowered also to influence the methods by which students in every department of the college are taught to arrange and coördinate the ideas imparted to them in their courses of instruction. Because what the profession is calling for, is a broader, riper education for engineers and a wiser comprehension of the fact that every man must give consideration to the audience of his fellows before whom his part as an educated man must be played.

The Executive Committee of the **Division of Mechanics** consists of the following members for the year 1931–1932:

G. P. Boomsliter, West Virginia University.
H. D. Churchill, Case School of Applied Science.
S. B. Folk, Ohio State University.
E. R. Maurer, University of Wisconsin.
E. W. Rettger, Cornell University.
N. C. Riggs, Carnegie Institute of Technology.
LeRoy Tucker, University of Illinois.
S. M. Woodward, State University of Iowa.
A. P. Poorman, *Chairman.*

Division of Engineering Drawing, *Chairman:* H. M. McCULLY; *Secretary:* JUSTUS RISING.

Executive Committee

C. L. SVENSEN	Term expires		1936
W. E. FARNHAM	"	"	1935
C. V. MANN	"	"	1934
F. G. HIGBEE	"	"	1933
W. G. SMITH	"	"	1932
T. E. FRENCH (ex officio)	"	"	1932

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

Officers, Engineering Drawing Division—Chairman, H. M. McCully, Carnegie Institute of Technology; Secretary, Justis Rising, Purdue University; Executive Committee: C. L. Svensen, Texas Technological College, term expires 1936; W. E. Farnham, Tufts College, term expires 1935; C. V. Mann, Missouri School of Mines, term expires 1934; F. G. Higbee, University of Iowa, term expires 1933; W. G. Smith, Northwestern University, term expires 1932; T. E. French (ex officio), The Ohio State University, term expires 1932.

New Policy—In order to stimulate the return of fact finding questionnaires and to make available the results of surveys of the questionnaire type, the Division pledged itself "to furnish promptly data for questionnaires concerning matters within the field of engineering drawing and allied subjects, when such questionnaires are approved by the executive committee of the Division, upon the condition that the author of the questionnaire file with the secretary two copies of the results of the investigation."

General Business—It was agreed by the Division to hold a joint session with the Division of English at the meeting in 1932. A committee was appointed to present a plan for an annual competition in drawing for the approval of the Division. The Research Committee, Professor C. V. Mann, Chairman, was authorized to coöperate in building comprehensive and objective type examinations for subjects within the field of the Division.

Reading for Teachers of Engineering Drawing—Contributed by Donald R. Dohner, Engineering Art Director, Westinghouse Electric and Manufacturing Company: "Art in Everyday Life" by Goldstein—Macmillan; "Principles of Design" by Batchelder—Inland Press; "Proportional Form" by Colman and Coan—Putnam; "The New World Architecture" by Sheldon Cheney, Published by Longmans; "Annual of American Design 1931" published by Ives-Washburn, New York; "New Dimensions" by Paul T. Frankl—Pacent & Clark; "Form & Reform" by Paul T. Frankl—Harpers; "Tyranny of the Skyscraper" by Frank Lloyd Wright, Creative Art, May 1931, pages 325–332; "Reasoned Design" by Nathan George Horwitt, Creative Art, May 1931, pages 377–379.

CONSULTANTS AT THE LIBRARY OF CONGRESS *

By H. W. TYLER

The resources of our great national library are well-known, particularly in the fields of law, history and economics, but the extent of its collections in the various branches of science are less generally appreciated.

With a view to facilitating the use of the library by scholars and at the same time giving the staff easier access to the advice of specialists whenever needed, a system of chairs and consultants has recently been established. In outlining the plan to the American Library Association in 1928, Dr. Herbert Putnam explained that the function of the occupant of the chair is neither teaching nor research, but interpretation. As members of university staffs, the business of specialists is to teach or to pursue intensive research of their own. In a word, to concentrate. But as members of a library staff and partaking of its spirit, their business would be to diffuse. A chair implies full-time service with some administrative responsibilities and as yet, no such appointments have been made in science. The consultant, on the other hand, is a member of the library staff on a part-time basis with no administrative responsibility, who cooperates with the staff in matters within his field, and in general, aims to make useful contacts with outside scholars, individually or collectively. Such a group of specialists in the service of the national library is a sort of informal faculty, offering to graduate students, in a measure, what is characteristic in the idea of a national university, mainly, convenient access to the principal collection of books and manuscripts in the United States and indirectly to the other extensive resources of the City of Washington.

Funds have been made available up to the present time for the appointment of seven consultants, three in literature and history, one each in economics, sociology, philosophy and science. The first consultant in science was Dr. Alfred C. Lane, of Tufts College, in the field of geology. The present consultant is Dr. H. W. Tyler, formerly of the department of mathematics in the Massachusetts Institute of Technology.

No consultant in science will naturally undertake personal responsibility in the field as a whole, but the more modest function

* Reprinted from SCIENCE, January 2, 1931, Vol. LXXIII, No. 1879, pages 13–14.

of acting as a medium of communication with specialists in the various fields seems within the range of practicability.

The object of this note is to make the plan better known to the readers of *Science* with the hope that they may be interested to communicate with the consultant, either in the sense of presenting questions on which information is desired, or offering suggestions for making the service increasingly useful.

NECROLOGY

Josiah William Votey, dean of the College of Engineering, University of Vermont, died at home September 16, 1931. His health had been visibly failing for about two years, but he was able to carry on a good part of his work until within a few weeks of his death.

Dean Votey was born in Ovid, N. Y., July 23, 1860. His father was pastor of the local Baptist church. Soon afterwards the family moved to Vermont, in whose schools the son received his elementary education. He prepared for college at Saxton's River Academy and entered the University of Vermont in 1881, graduating in 1884. At graduation he received Phi Beta Kappa honors.

The same year he was appointed assistant to Prof. V. G. Barbour and for several years they constituted the engineering faculty. His promotion was rapid and in 1901, upon the death of Professor Barbour, he became dean of what had grown from a small department of the University to be the College of Engineering. His summer vacations for several years were spent in the employ of the U. S. Coast and Geodetic Survey, in the work of which he became expert.

In later years he transferred his activities from surveying and highway work, in which he had also specialized, to sanitary engineering, in which he was widely read and deeply interested. In addition to his courses in the subject in the College of Engineering he served as engineer for the State Board of Health, a position to which he was appointed in 1908 and which he held at the time of his death.

Dean Votey was preëminently a teacher. It was the work of his choice. From the first he was successful in the classroom. He was interested in the students and understood their limitations, was patient with those slow of understanding and tireless in his efforts to help them over hard places. He understood his subjects well and had a natural gift for clear exposition. He brought into the classroom an enthusiasm that was contagious and well calculated to arouse and sustain interest in the subjects. To teach well so many subjects as fell to him, especially in the early years of his teaching, was possible only to one who possessed the real instinct of the teacher.

In his make-up there was a strong artistic strain. He was very fond of music and in early life was a member of musical organizations and for several years a member of the Baptist choir. He was

a bird lover and a close and interested observer of bird life. He was fond of good pictures and various works of art, including poetry. He delighted in fine scenery.

His reading was extended and varied, especially in the field of engineering. He was deeply interested in engineering devlopments of all sorts, read with avidity engineering periodicals, and was easily one of the best informed men in this field. Whether in public discourse or in private conversation one was made to feel that Dean Votey's mind was a veritable fountain of accurate information concerning what is going on in the engineering world. His work as a teacher and his attainments as a scholar received academic recognition by the conferring upon him the honorary degree of D.Sc. by the University in 1911, and the same degree by the University of Maine in 1922.

Dean Votey was a companionable man, and his active mind, retentive memory, deep and broad interest in all life and in people, combined with an enviable gift of expression, made his companionship informing and delightful. These gifts also were used to great advantage in the classroom in arousing interest in otherwise dry subjects.

BOOK REVIEWS

Problems in Alternating Currents. By WALDO V. LYON, Professor of Electrical Machinery, M. I. T. 233 pages (second edition). McGraw-Hill Book Co., 1931. Price $2.25.

Professor Lyon has divided his book "Problems in Electrical Engineering" into two books, "Problems in Direct Currents" and "Problems in Alternating Currents." The following statements pertain to the book "Problems in Alternating Currents."

The book contains an ample supply of good practical problems for students of alternating currents. The chapters with headings, number of problems and pages are as follows:

Chapter	Title	Number of Problems	Pages in Book
1	Single Phase Circuits—Sinusoidal Potentials....	354	70
2	Single Phase Symbolic Method.....	228	41
3	Harmonics in Single Phase Circuits.....	106	32
4	Transients in Single Phase Circuits.....	53	14
5	Polyphase Circuits—Sinusoidal Potentials.....	127	28
6	Polyphase Circuits—Harmonics.....	88	31
7	Mutual Inductance.....	56	17

In the revision of this book, which was first published twenty-three years ago, nearly all of the original problems have been included, and to them have been added a large amount of new material. Quoting from the author's Preface, "wherever possible problems involving the same principles are grouped together, and the problems in each group are arranged approximately in order of difficulty." Also, "The brief statements of the fundamental principles that headed each chapter of the original edition have been omitted as they now seem quite inadequate. The answers to about one-fourth of the problems have been provided."

The treatment of alternating current problems is much more thorough and complete in the new edition than the original. This book should supply adequate problem work to students of Electrical Engineering in the junior year.

R. C. G.

Problems in Direct Currents. By WALDO V. LYON. Second edition. McGraw-Hill Book Company, Inc., 1931. 154 pages. Price $1.75.

The author has divided his book "Problems in Electrical Engineering" into "Problems in Direct Currents" and "Problems in Alternating Currents." A good step in the right direction.

The new book contains nearly all the original problems in D.C. either in their original form or with changed constants. The chapter on generators and motors has been entirely omitted. To the retained problems there has been added about 75 per cent new material. Also there have been added two chapters of 222 problems on transient currents. There is a total of 768 problems in the new book.

The discussion at the beginning of each chapter has been omitted in the revised book.

When the material for a problem is such that it would make the solution too long, the problem is divided and numbered separately.

The chapter headings and the number of problems are as follows:

1. Resistance—75 Problems
2. Ohm's Law—98 Problems
3. Kirchoff's Laws—76 Problems
4. Energy and Power—79 Problems
5. Magnetic Field—118 Problems
6. Electrostatic Field—100 Problems
7. Transient Currents R and L—114 Problems
8. Transient Currents R and C—108 Problems

This book should find application as a text for a problem course for third year students in Electrical Engineering.

P. E. R.

Applied Kinematics. By J. HARLAND BILLINGS of Drexel Institute. 173 pages. Published by D. Van Nostrand Co. Price $2.50.

This book is intended for the ordinary course in mechanisms and is therefore not expected to be a complete treatise on the subject. It gives a large number of practical examples which illustrate the different elements studied. Problems for laboratory work are given.

The methods of finding velocities in mechanisms are similar to the conventional methods found in most texts. While these methods are general it is unfortunate that the method of relative velocities, which is much more practical, has not been included. Also too much emphasis is put on gear teeth and not enough space has been

devoted to gear trains. Most students will have much more use for the principles involved in gear trains than for information on the form and action of gear teeth. The chapter on flexible connectors is mostly of a descriptive nature and does not go into the theory or principles involved in their practical application as a mechanism.

E. N. K.

Railroad Curves and Earthwork with Tables. C. FRANK ALLEN, Professor of Railroad Engineering, Massachusetts Institute of Technology. 235 pages; 290 pages, tables. Seventh Edition, 1931, McGraw-Hill Book Company. Price $4.00.

This well-known railroad handbook has been improved and brought up to date by the addition of several new tables and a new chapter on the string lining of curves. This is the first time this method has been published in such a concise and workable form. The author is to be congratulated on confining his subject matter to railroads and not introducing highway location which would perhaps spoil an otherwise excellent book.

L. C. McC.